Toy Adaptation Program Workshop: Enriching First-Year Engineers by Teaching the Electronic Toy Adaptation Process

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***Abstract* – For many first-year engineering students, the efficacy and purpose of their degree is not always apparent when they take their initial engineering classes. The Toy Adaptation Program (TAP) teaches incoming students the procedure involved with reverse engineering an electronic toy so that it can be more easily activated by children with disabilities. By taking this approach to learning, the goal is to benefit the community by increasing the accessibility of these expensive toys while teaching first-year engineers soldering, basic circuitry, and problem-solving. In the end, we hope that students will be empowered to make a difference in the world with the skills and experiences they gain from their first year as engineering students.**

Index Terms – community engagement, student enrichment, toy adaptation

PROGRAM BACKGROUND

The Toy Adaptation Program (TAP), grounded in service and experiential learning, fills an educational and financial need by adapting toys for children with special needs [1]. We do this through labs with first-year engineering students, workshops with families, and other events with community and corporate partners [1]. 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 original method AND by an external switch specific to the child's needs and abilities [2]-[3]. The goal is to use this process of applying engineering knowledge in order to have a direct impact on the lives of children with disabilities.

For children, toys are not only an important factor related to entertainment but are also a primary tool in developing cognitive abilities. The skills learned through playing with electronic toys have the potential to greatly improve the future developmental growth of a child [4]-[5]. It also helps them understand the world around them. Teamwork, decision-making, and self-mastery are examples of the proficiencies children gain through their interactions with toys [4]. This program encompasses two aspects: a community component and an education component for engineering students. By providing students with the tools and thinking necessary to adapt a toy, this workshop gives students the freedom to apply their knowledge of circuitry, soldering, and forward-thinking in problem-solving. In the end, we hope that students connect their learning to the positive impact they can have through the application of their engineering skills.

TAP OBJECTIVES

TAP has multiple objectives that focus on education and community support. Specifically, TAP:

- Teaches students the process of reverse engineering as it relates to taking apart an electronic toy with the intent of adapting its circuit and then repackaging the toy securely;
- Exposes students to the idea that the skills and experiences resulting from their education can have a positive and meaningful impact on the lives of their community;
- Gives students further motivation to continue their studies as an engineering major;
- Provides an opportunity for the development of leadership skills to upper class engineering students through the mentorship of freshman engineers during the workshop.
- Encourages students to seek opportunities to engage in service in their community;
- Positively impacts the lives of others in the community who are either children or the family of children with physical limitations by providing low-cost, conveniently available adapted toys; and
- Raises awareness of the importance of play for children, especially regarding the use of adapted electronic toys by children with physical or cognitive limitations.

WORKSHOP DESCRIPTION

We can accommodate approximately 50 people for this workshop. A presentation will first be given to educate participants on the need for adapted toys and the mission of TAP. Basic soldering safety and techniques will be reviewed before any adaptation takes place. Participants will then work in groups or pairs to adapt an electronic toy pre-

selected by TAP. Each group will work together to unpackage and analyze the toy for its main function, which will then be adapted. The group will carefully open the toy and locate the circuitry components associated with the function to be adapted. Through trial and error, groups will proceed to locate two nodes that complete the circuit and activate the toy when bridged. From here, participants will solder the wire attached to the female, universal jack to the toy at the two nodes. Next, groups will close the toy (sewing, repositioning screws, etc.) while leaving enough room for the additional wire to exit. Once the toy is closed and tested, participants will neatly repackage the toy and bring it to a TAP team member for a final check.

After the workshop, the toys that are adapted will be donated to locate families and toy lending libraries. Additionally, we hope that this workshop will encourage participants and their colleagues to attend a future workshop which will be held at the American Society for Engineering Education Annual Conference in 2017 in Columbus, OH. Finally, we hope that this workshop will lead to future collaborators who are interested in conducting toy adaptation activities at their home institutions.

WORKSHOP TEAM

Dr. Rachel Louis Kajfez is an Assistant Professor of Practice in the Department of Engineering Education and the Department of Civil, Environmental, and Geodetic Engineering 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.

Elizabeth Riter 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.

Molly Mollica earned her B.S. in Biomedical Engineering and her M.S. in Mechanical Engineering from The Ohio State University. She is currently pursuing a Ph.D. in Bioengineering from the University of Washington.

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 is a second year undergraduate honors student seeking his B.S. degree in Mechanical Engineering at The Ohio State University. He has been a Toy Adaptation Program Intern with the Engineering Education Department at the Ohio State University since Autumn 2015.

REFERENCES

[1] Mollica, M. Y., Kajfez, R. L., Riter, E., West, M., & Vuyk, P. (2016). *Community Service as a Means of Engineering Inspiration: An Initial Investigation into the Impact of the Toy Adaptation Program.* Paper presented at the ASEE National Conference and Exposition, New Orleans, LA.

[2] 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.

[3] Proença, J. P., Quaresma, C., & Vieira, P. (2014). New application: Adaptation of toys for children with multiple disabilities. *Procedia Technology*, *17*, 351-358.

[4] 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.

[5] Besio, S. (2004). Using assistive technologies to facilitate play by children with motor impairments: A methodological proposal. *Technology and Disability*, *16*(3), 119-30.