The Impact of a Lego Exhibit on Awareness of the Roles and Identities of Engineers

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Abstract: This study measures the impact of exposure to an engineering exhibit on children's awareness of the roles and responsibilities of engineers. We studied 250 children, aged 8-16, in a quasi-experimental design. Results indicate the exhibit did not have a major impact in children's perceptions of who engineers are but did positively impact what they knew about what engineers do as part of their job.

Keyword: Engineering, Lego, Informal Learning, Museums

Introduction

Many children have little exposure to engineering and may not have access to the subject in their school. Informal science institutions can help fill in the gap by creating engineering curriculum and exhibits (Engineering is Elementary, 2017). This study is about one such exhibit that incorporates engineering curriculum with a popular childhood toy: Lego bricks. Our guiding research question was, "What is the impact of visiting the exhibit on guest awareness of the roles and identities of engineers, designers, architects and builders?"

Literature review

There is a current need to increase the number of students prepared for careers in science, technology, engineering, and math (STEM) (U.S. Department of Education, 2015). Previous research suggests that students do not have a strong awareness of what engineers do and conceptualize them mainly with fixing, building, and working on things (Capobianco, Dux, Mena, & Weller, 2011; Cunningham, Lachapelle, & Lindgren-Streicher, 2005). Informal science experiences can improve science understanding and increase participation in scientific activities and awareness of scientific careers (Bell, Lewenstein, Shouse, & Feder 2009; Banks et al., 2007). But despite a growing number of engineering-based museum exhibitions, there is little research on the impact these opportunities have on visitors' understanding of engineering careers.

Methods

We collected data through guest assessments. Families with children 8-16 were recruited as they passed a common area near the exhibit entrance and exit. Those who had previously attended the exhibit were grouped into the treatment condition, while those that had not yet attended were placed in the control group. While the children completed their assessments, the parents completed a demographic background survey. One hundred and thirty guests were recruited into the treatment condition and 120 in the control. The overall gender distribution was 54% male and 46% female. The mean age was 10 (1.9 SD). The top three self-identified racial groups were White (84%), Asian (8%), and African American (5%). About 12% identified as Hispanic.

The child assessment consisted of two sections. The first was modeled after the Draw an Engineer (DAE) instrument that asked children to draw an engineer at work and write a short description of what they are doing (Knight & Cunningham, 2004). The second assessment was based on the What is an Engineer (WIE) instrument (Cunningham, Lachapelle, & Lindgren-Streicher, 2005). The WIE consists of 16 icons that show someone at work, with a small description below them. The child is asked to circle the icons that represents engineers at work.

Drawings from the DAE instrument were analyzed by researchers using the rubric described by Weber, Duncan, Dyehouse, Strobel, & Diefes-Dux (2011). The rubric utilizes 24 items to encapsulate the different aspects of each of the drawings. T-tests reveal the 'train' and 'fixing' variables were the only significant differences between the control and treatment. For the WIE instrument we found differences between the conditions on 6 of the 16 icons, significance was tested using independent samples t-tests (Table 1).

Table 1: "What is an Engineer"

"What is an Engineer?" Instrument

Icon Label	Engineering Task (Y/N)	Treatment	Control
Read about Inventions*	Y	.42	.28
Design Ways to Clean Water**	Y	.52	.32
Work as a Team***	Y	.78	.57
Test Things***	Y	.67	.42
Repair Cars	N	.59	.69
Design Things***	Y	.85	.67
Clean Teeth*	N	.08	.02

Note. Percentages reflect number of responses that circled the icon. Each icon had an image with the label beneath it.

Conclusion

Results suggest that the exhibit was successful in increasing awareness of roles an engineer but did not strongly impact their conceptions of who engineers are. Using the rubric, the DAE only had 2 differences in drawings between the control and treatment, “train” and “fixing”, in both cases the control group drew these items more frequently. This ties into other studies finding strong associations between engineers and trains when using the DAE (Capobianco, Diefex-Dux, Mena, & Weller, 2011; Knight & Cunningham, 2004; Fralick, Kearn, Thompson, & Lyons, 2009; Karatas, Micklos, & Bodner, 2011). In those studies, it is generally thought that trains are commonly drawn due to the term engineer being used to describe train crew. However, the WIE had significant differences in 6 icons (Table 1). All but one of these categories are aligned with what an engineer would do in their job. Not surprisingly, the exhibit provides opportunities for children to take part in activities related to these categories. This study provides evidence about strengths and limitations for using an exhibit-based informal learning space to introduce children to engineers.

References

Banks, J., Au, K. H., Ball, A. F., Bell, P., Gordon, E. W., Gutierrez, K. D., . . . Zhou, M. (2007). *Learning in and out of school in diverse environments: Life-long, life-wide, life-deep.* Seattle, Washington: The LIFE Center.

Bell, P., Lewenstein, B., Shouse, A. W., Feder, M. A. (2009). *Learning Sciences in Informal Environments: Peoples, Places, Pursuits*. Washington, DC: The National Academies Press.

Capobianco, B.M., Diefes-Dux, H. A., Mena, I., & Weller, J. (2011). What is an Engineer? Implications of Elementary School Student Conceptions for Engineering Education. *Journal of Engineering Education, 100*(2), 304-328.

Cunningham, C. M., Lachapelle, C., & Lindgren-Streicher, A. (2005, June). *Assessing elementary school students' conceptions of engineering and technology*. Paper presented at the ASEE Annual Conference and Exposition*,* Portland, OR.

Engineering is Elementary. (2017). *About Us*. Retrieved from https://www.eie.org/about-us

Fralick, B., Kearn, J., Thompson, S., & Lyons, J. (2009). How middle schoolers draw engineers and scientists. *Journal of Science Education and Technology*, *18*(1), 60-73.

Karatas, F.O., Micklos, A., & Bodner, G.M. (2011). Sixth grade students' views of the nature of engineering and images of engineers. *Journal of Science Education Technology*, *20*(2), 123-135.

Knight, M., & Cunningham, C.M. (2004, June). *Draw an engineer test (DAET): Development of a tool to investigate students' ideas about engineers and engineering*. Paper presented at the ASEE Annual Conference and Exposition, Salt Lake City, UT.

U.S. Department of Education (2015). *Science, Technology, Engineering and Math: Education for Global Leadership.* Retrieved from https://www.ed.gov/stem

Weber, N., Duncan, D., Dyehouse, M., Strobel, J., & Diefes-Dux, H. A. (2011). The development of a systematic coding system for elementary students' drawings of engineers. *Journal of Pre-College Engineering Education Research (J-PEER)*, *1*(1), 6.