TEST: Teaching Early Safety Testing

The Case for Expanded Product Safety Design Training

High School Version

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Introduction

In 2003, KID Program Associate Megan Miller wrote the paper, “The Case for Expanded Product Safety Design Training.” In this paper she reviewed how college engineering programs put very little concern of safety into their curriculum. She found a wide array of articles and resources to show how pertinent this absence was to the design of safe products then and in the future. From this, the TEST program was incorporated into various undergraduate engineering programs in the Midwest.

This literature review provides a similar overlook at engineering literature with an added focus on high school education. A wide array of materials are reviewed to gain a better understanding of how high school educators are incorporating ethics, design safety, and standards into their classrooms – and where these ideas could be incorporated in the future. Also included in this update are the online standardization and accreditation resources for college engineer programs as a resource since there are no K-12 national standards regarding engineering education.

Finally, resources from Project Lead the Way (PLTW) and KID’s website on the TEST program’s progress are documented at the end.

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Articles and Textbooks

Aneesh, A. (2008). *Political and Legal Anthropology Review, 31*(1), 154-157 [Review of book The Politics of Product Design and Safety Law in the United States by Sarah S. Lochlann Jain].

This author positively reviews the book *The Politics of Product Design and Safety Law in the United States* by Sarah S. Lochlann Jain. In this book, Jain outlines how inequality is sustained through our legal system, specifically within product safety lawsuits. Aneesh provides insight to Jain’s research on how lawsuits often avoid the bigger issue of product and work safety by focusing on one specific instance of faulty engineering. The article criticizes the idea of how injury comes about due to an exception. Although not directly related to child product safety or high school education, this article gives good insight into how injuries from to inadequate product design are treated.

Baker, D., White-Taylor, J., Ganesh, A., Ganesh, T. G., Krause, S., Roberts, C., Morrell, D. (2014, September 1). *Engineering: An Introduction for High School*. Retrieved from https://www.ck12.org/book/Engineering%253A-An-Introduction-for-High-School/

This online text, which is easily accessible to teachers and students, provides an overview of the entry-level engineering principles. It is designed to be a student’s first

introduction to engineering concepts, such as the design process. There are sections on engineering history, engineering and nature, engineering and society, and how science and mathematics appear in engineering. The book does speak to the relationship between engineering and society, but only in a progress-oriented fashion and not in a way that educates students on the dangers of faulty product designs. Although, within the design chapter, the book discusses the variety of ways a design can go wrong and how to test a product to make sure it will work in the real world. After understanding these basic concepts, students in high school can begin to discuss product safety, standards, and engineering ethics.

Brauer, R. L. (2006). *Safety and Health for Engineers*. Hoboken, NJ: John Wiley & Sons, Inc. Retrieved from http://samples.sainsburysebooks.co.uk

This book outlines general requirements for engineers within both a legal and scientific context. The author delves into need for engineers to understand basic safety regulations. He also outlines the newer technologies used in safety practices. This book could be beneficial to the TEST program and curriculum in that it incorporates a general overview along with a detailed view on newer methods of practicing safety within the profession.

Brophy, S., Klein, S., Portsmore, M., & Rogers, C. (2008). Advancing Engineering Education in P-12 Classrooms. *Journal of Engineering Education, 97*(3), 369-387. doi: 10.1002/j.2168-9830.2008.tb00985.x

This article highlights preschool – 12th grade engineering programs and curriculums in various countries. The authors note that an engineering curriculum or focus within pre-college education is imperative because it teaches youth how to think creatively, design solutions to problems, and test their solutions to see if they work in a real-world context. However, they note that engineering curriculums can be hard to implement for two reasons: First, many teachers do not specialize in engineering, and second, there are always a variety of solutions to engineering problems, which can make measuring success difficult for teachers. Overall, the authors describe how many engineering curriculums are pushing today's youth to be creative problem solvers.

Brown, R. A., Brown, J. W., & Berkeihiser, M. (2013). *Engineering Fundamentals: Design, Principles, and Careers*. Tinley Park, IL: Goodheart-Willcox Publisher.

This textbook describes the foundational principles of the engineering design process and then dedicates a chapter to each engineering discipline. The text serves as an introduction to the engineering world for students and outlines how they could work in engineering in a variety of different ways. While in the text there is nothing related to product safety or children's safety, it can be referred to by KID staff and high school students to remind ourselves of how and where product safety and standards should be incorporated within each engineering discipline.

Carr, R.L., Bennett IV, L.D., Strobel, J. (2012). Engineering in the K-12 STEM Standards of the 50 U.S. States: An Analysis of Presence and Extent. *Journal of Engineering Education, 101*(3), 539–564.

This article presents an overview of U.S. K-12 engineering standards in 41 states. Since there is no national K-12 engineering education standard, states are left to their own devices to create and measure success in K-12 engineering-focused classrooms. The researchers found that “41 of 50 states have engineering content in their educational standards”, and 36 states have a “strong presence of engineering.” Researchers analyzed how many times various words and concepts showed up in the 41 state’s standards regarding engineering and they found that the word “safe” appeared 70 times, the word ethics appeared 0 times, and the most common word was “design” which appeared 1,310 times. As KID begins incorporated TEST into high school classrooms, it is important to understand the current standards that guide high school engineering education and what previous knowledge students will have regarding safety and ethics.

Crane, A. & Kazmi, B. A. (2010). Mapping Impacts, Managing Responsibilities. *Journal of Business Ethics, 91*(4), 567-586

This article addresses the often overlooked impact businesses have on children. They provide an overview on the various ways businesses affect child safety, one way being product safety. To conclude this article provides a framework for how businesses should map their responsibilities to children. They provide guidelines for addressing the responsibilities and constraints many businesses face in creating measures that keep children safe.

Handley, B., Coon, C. & Marshall, D. M. (2012). *Principles of Engineering (Project Lead the Way) 1st Edition*. Clifton Park, NY: Delmar, Cengage Learning.

This textbook is designed specifically to be incorporated into the Project Lead the Way (PLTW) foundational engineering course. It covers engineering concepts, mathematics, and scientific principles that high school students will discuss in this program. Some of the schools where KID will present the TEST program are part of the PLTW program, so it is imperative that the foundations of this course are understood by KID staff. The textbook has a design process chapter, however, it focuses mostly on the tools used to create a design rather than the challenges of designing a product for human use in today’s world. There is also no specific section on ethics in engineering.

Karsnitz, J. R., O'Brien, S., & Hutchinson, J. P. (2013). *Engineering Design: An Introduction 2nd Edition*. Clifton Park, NY: Delmar, Cengage Learning Products.

This text serves as a commonly used reference in high school engineering classes. The focus on this textbook is on the design process, and therefore does discuss many of the challenges that come with designing product for human use. One of the chapters is titled

"Human Factors in Design and Engineering," which is a promising step towards speaking about safety in the design process at an earlier age. The text also has a chapter on testing and evaluating products, gearing students to understand the importance of testing product before they enter the marketplace.

Kurihara, S. (2006). The General Framework and Scope of Standards Studies. *Hitotsubashi Journal of Commerce and Management, 40*(1 (40), 1-18. Retrieved from http://www.jstor.org/stable/43295004

The history and evolution of standards are discussed in this article. The author provides a general reasoning for why standards developed, including the internationalization of business and increased consumer demand for health, environmental, and safety standards. It is argued that the study of standards should become an academic discipline as standards take more precedence in the world. A list of core questions to be asked in a class on standardization are included and discussed. This research could be used in TEST as a way to discuss the importance of standards and how they must be constantly evaluated and evolved.

Leveson, N. G. (2011). *Engineering a Safer World: Systems Thinking Applied to Safety.* Cambridge, MA: The MIT Press. Retrieved from www.books.google.com

In this book, the author uses system theory to describe how engineers should think about safety practices. She describes how it is increasingly difficult to incorporate safety in a world with increasing complexities in the relationship between humans and automation. The book argues for more government regulation of products since people are decreasingly in control of their own safety in regards to products. The difference between reliability and safety is touched on, it is mentioned that engineers must think of the two differently. She notes how a product can be reliable and unsafe, and how this needs to change.

Osborne, J. M., Shibl, R., Cameron, C. M., Kendrick, D., Lyons, R. A., Spinks, A. B., Sipe, N., & McClure, R. (2015). Validity of parent's self-reported responses to home safety questions. *International Journal of Injury Control and Safety Promotion, 23(3)*, 1-11. doi: 10.1080/17457300.2014.992348

This study surveyed parents and their safety practices at home. Through a combination of the Home Injury Prevention Survey and home observations undertaken by trained researchers, the authors were able to get a better understanding of to what extent parents are practicing safety measures in the home. They found that parents over-reported their safety practices for approximately half of the items and under-reported for one-third of the items. These results speak to the validity of parent responses regarding safety. TEST engineers can use this study to help them understand that products need to be safe by design due to the fact that parents often believe they are acting in the safest manner when they are not.

Schlegelmilch, B. B., & Öberseder, M. (2010). Half a Century of Marketing Ethics: Shifting Perspectives and Emerging Trends. *Journal of Business Ethics*, *93*(1), 1-19.

This articles presents a historical view of ethics within marketing. The authors describe how the marketing and general public view of ethics within business has changed over time. It serves as an interesting background for conversation around ethics in businesses and professions. It also exclaims how imperative it is that marketing agencies make ethical standards more mainstream.

Sciascia, A. (2006). Safe or Sorry: How the precautionary principle is changing Europe's Consumer safety regulation regime and how the United States' consumer product safety commission must take notice. *Administrative Law Review, 58*(3), 689-707. Retrieved from http://www.jstor.org/stable/40711928

This article compares the United States' CPSC with the European Union's General Product Safety Directive. The European Union based their laws on product safety on the precautionary principle instead of the cost-benefit approach that the U.S. uses. The author argues that the United States should mimic Europe and incorporate the precautionary principle into their regulatory laws and organizations because it considers the safety of the consumers over market drive.

Professional Standards & Guidelines

Code of Ethics for Engineers. (2016). National Society of Professional Engineers. Retrieved from https://www.nspe.org/resources/ethics/code-ethics

The code of ethics provides professional and ethical standards for engineering students and professionals. This code is relevant to TEST and to KID in that it many of its outlined standards relate to health and safety. It explicitly states how engineers must "hold paramount the safety, health, and welfare of the public." Engineers must create products that comply with these standards which allows space for TEST to aid engineering students in understanding the importance of product safety.

Committee on Standards for K–12 Engineering Education. (2010). *Standards for K-12 Engineering Education?* Washington D.C.: The National Academic Press. Retrieved from http://teachingcommons.cdl.edu/ngss/engineering_design/documents/pdf_000.pdf

This report is the culmination of a two-year investigation by the Committee on Standards for K–12 Engineering Education on the potential development of engineering standards in the U.S. K-12 education system. They concluded that developing and implementing engineering-specific standards nationally would be too difficult and ultimately fail. Instead, the recommend that engineering standards be incorporated into other mathematics and science classes on both a state and national level. They also

argue that the “big ideas” in engineering should be incorporated into other disciplines’ standards.

Criteria for Accrediting Engineering Programs, 2016-2017. (2016). Accreditation Board for Engineering and Technology, Engineering Accreditation Commission. Retrieved from http://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2016-2017/

This document provides guidelines to accredit undergraduate and graduate engineering programs. There are criteria listed at the broad level and for specific programs. There was little mention to studying safety, and when it was mentioned it was mentioned briefly in concerns with designing within the constraints with health and safety. In the section on proposed changes there is a section that states how engineering should be a process to create within the standards of health and safety, among other criteria.

Safety aspects — Guidelines for child safety in standards and other specifications. (2014). ISO/IEC Guide 50:2014. International Organization for Standardization and International Electrotechnical Commission. Retrieved from https://www.iso.org/obp/ui/#iso:std:iso-iec:guide:50:ed-3:v1:en

This document provides a general outline for child safety. It provides information that is intended to serve as a basis of standards for organizations that create products for children. It mentions specific dangers and hazards that children face, and addresses the context and environments in which these dangers arise. This document provides critical information for KID and TEST through the detailed outline of child safety policies.

Computer Programs

Consumer Product Safety Training. (2016). Intertek Group. Accessed through http://www.intertek.com/risk-management/safety-training/.

Intertek provides an array of product safety trainings for businesses. They hold conferences with various experts in the legal and product testing authorities on aspects of product safety. They give trainings so that professionals and the general public better understand all the features of product safety.

Courses. (2016). American National Standards Institute (ANSI). Accessed through https://www.standardslearn.org/courses.aspx.

The American National Standards Institute (ANSI) provides an array of courses on standardization in the United States. There are a variety of courses on the history of standards, the issues present today, the legal issues in standard-setting, and international standards. All of these courses provide crucial information on how to

understand the formation of standards. These courses could be incorporated into TEST curriculum or provided to students to view.

Online Resources - TEST Progress

Kids In Danger. (2016). Teach Early Safety Testing (TEST). Retrieved from http://www.kidsindanger.org/programs/teach-early-safety-testing

This website is run by KID and provides an overview of the TEST program. KID provides information on TEST funding, background, progress, and past student designs. There are links available to access all the information in more depth.

Kids In Danger. (2016). Test: Student Projects. Retrieved from http://www.kidsindanger.org/docs/TEST/TEST_student_projects_flyer_updated1.pdf

This document provides an overview of the student projects created through the TEST program. With each project there is a description of the problem and the solution.

Kids In Danger. (2016, March). TEST Progress Check. Retrieved from http://www.kidsindanger.org/programs/test-progress-check/

This website run by KID provides examples of all the Test projects created by students from July 2003 to March 2016. Each description details the school, students, and intent of the specific project. There are also links to YouTube videos or pictures of the project.

Online Ethics Center for Engineering. (2014, Summer). TEST - Teach Early Safety Testing. Retrieved from www.onlineethics.org/Resources/TeachingTools/Modules/28278/28317.aspx

Materials provided by Kids In Danger. Describes the curriculum KID provides on incorporating safety into the engineering classroom. Materials describe TEST program and provide structure for a variety of classes. The curriculum is designed to be taught at an undergraduate level.

Project Lead the Way. (2017). *PLTW Engineering (9-12*) Retrieved from https://www.pltw.org/our-programs/pltw-engineering.

This website outlines the Project Lead the Way (PLTW) curriculum, goals, and career paths for high school students interested in engineering. Their website outlines how they align their program to the standards of the local schools, making it a flexible option for teachers interested in incorporating this program into their schools. It also outlines how the program curriculum is consistently updated by educators and industry leaders to keep the programs relevant to today's ever-changing world.