

VALUE ENGINEERING FOR KIDS

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ABSTRACT

This paper discusses opportunities to apply Value Engineering at the grade school level. In the last two decades, there has been an increased focus in STEM (science, technology, engineering, and mathematics) education in the United States. Equipping grade school learners with value methodology (VM) helps to train them in critical thinking and prepares them early for STEM-related careers. This pre-college exposure to and awareness of VM in conjunction with STEM can be far-reaching for the health and future of the value industry. Case study: a Girl Scout troop applying VM to its design project.

BACKGROUND

A national crisis has been widely recognized among leaders and researchers: in the United States (U.S.), there is a shortage of skilled technologists to staff positions in the STEM (science, technology, engineering, and mathematics) fields. One study projected that the demand will exceed the supply by one million by 2020 (Israel, 2017). In an attempt to fill this skills gap, there has been an increased focus in STEM education, with the goal to prepare “a generation of citizens capable of making evidence-based decisions required for the innovative fields that are driving the 21st-century economy” – “a workforce of skilled science and technology innovators to address our most pressing challenges and to provide a pathway to continued prosperity” (Groome, 2017). In a March 2017 hearing of the Senate Labor, Health and Human Services, and Education Appropriations Subcommittee, it was emphasized that STEM “is critical for the economic competitiveness and security of our nation” and that it would likely have a role in every field of work in the future (American Institute of Physics, 2017). Studies have indicated that academic preparedness is key to college students completing their STEM degrees, and “a strong pre-college background in STEM subjects is required to do well in those fields in college” (Israel, 2017). To this end, the Elementary and Secondary Education Act as amended by the Every Student Succeeds Act has made available Federal formula grant funds to state and local educational agencies and their partners to support innovative, equity focused STEM education strategies for pre-kindergarten through grade 12 (U.S. Department of Education, 2017).

PROPOSAL

Standards based on research from the National Science Foundation that raise the bar for integrating STEM content into elementary and high school classrooms have been released, and programs such as Engineering is Elementary (EiE) and Innovation Portal have been successfully implemented (Draxler, 2013). But a survey of the literature resulted in no findings of value methodology (VM) included in U.S. STEM education curricula to date.

In Japan, the Society of Japanese Value Engineering (SJVE) has introduced the concept of value engineering (VE) in schools through the pre-existing Education for Sustainable Development (ESD) program (Miyamoto, 2016). The 2016 Director and Secretary General of SJVE, Akio Miyamoto, wrote in the October 2016 edition of *Value World*: “If VE is firmly established into the ESD program, the children of today will be able to take actions to resolve and overcome various global challenges we are currently facing in a proactive manner.” SJVE’s short-term goal was to develop VE textbooks and teaching materials for primary to high school curricula and to train school teachers in VE fundamentals (Miyamoto, 2016).

Similarly, VM can be introduced to grade school learners in the U.S. through STEM education. Federal funds (Title II) are in place specifically to train educators to teach new STEM concepts and approaches (U.S. Department of Education, 2017). As students exposed to VM enter the workplace, they would be mindful of the benefits of integrating VM into their work, potentially leading to new opportunities to apply

VM throughout industry, as schematically shown in Figure 1.

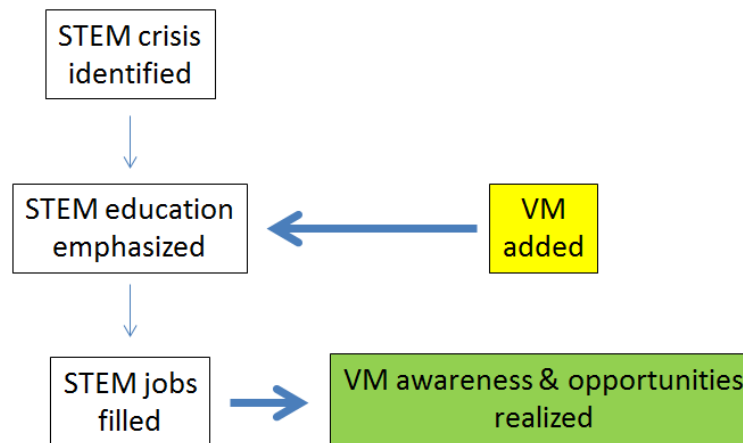


Figure 1. Value Methodology Inclusion in STEM Education

VM would serve STEM education’s goal of preparing the workforce for evidence-based decision making. As Law wrote in the October 2017 edition of *Value World*, “the VM work plan is designed to support this approach. Evidence is gathered by the team during the Information and Analysis Phases of the VM study.... Evidence is also used during the Development Phase to support the team’s recommendations.”

STEM education programs already in place can readily incorporate VM into their curricula that emphasize problem-solving and the engineering design process. For example, the EiE curriculum uses the following five-step cycle to guide students through engineering design challenges: (1) ask, (2) imagine, (3) plan, (4) create, and (5) improve. In the “imagine” step, VM can be applied to brainstorm ideas for solutions and choose the best one. Function analysis can be applied to EiE lessons in which students consider cost and how to use the fewest number of materials to achieve their goal.

In 2016, the White House received over 200 submissions of innovative work promoting STEM learning from across the country – state and local entities, foundations, non-profits, media organizations, technology companies, research institutions, and museums – to bring new active STEM content for children to millions of households across the nation (The White House, Office of the Press Secretary, 2016). These were potentially 200+ untapped opportunities to realize VM awareness and education for the U.S.’s 21st century economy – and to support SAVE International’s PACE Initiative. PACE is the acronym for “Promote VM awareness, Advocate use of VM, Certify members, and Educate members;” the initiative focuses on the health and future of the value industry (Wilson, 2016). In the September 2016 edition of *Value World*, Wilson reminded the readership: “There are many things that we, as value professionals, can (and should) be doing to strengthen our industry to ensure lasting relevance. For example, we all need to take ownership in promoting VM awareness and advocating the use of VM. SAVE can certainly assist in defining a clear, concise, and consistent message, but it’s us – the members – that are likely best positioned to deliver the message. We need to accept that each of us can be an agent of change.”

CASE STUDY

To equip themselves for their FIRST Lego League (FLL) Hydrodynamics Challenge, members of Girl Scout Troop #3213, also known as the Weirdbots, engaged in the “Know Your Water” field trip hosted by the Metropolitan Water District of Southern California (Metropolitan) and subsequently enlisted the volunteer help of a Metropolitan engineer to brainstorm their FLL project to design a solution to a human water cycle problem. This Metropolitan engineer – also an associate value specialist – introduced the Girl Scouts to VE and applied the VM Job Plan to brainstorm and develop the troop’s design project.

FIRST is an internationally recognized robotics program that “sparks interest in STEM, [it] has impressed educators by building hands[-]on STEM skills in diverse populations. FIRST students are twice as likely to major in engineering or science. Further down the line, 45% (twice the national average) of students involved in the FIRST program end up in STEM careers” (Israel, 2017). Its acronym stands for “For Inspiration and Recognition of Science and Technology.”

Figures 2 through 6 provide an excerpt of the September 2017 VE presentation to the Girl Scout troop, in which the “Project In-Depth” instructions from the FLL *2017/2018 Challenge Guide* were synthesized into a direct application of the VM Job Plan. Function analysis of the human water cycle is shown in Figure 7.

Value Engineering (VE)

- Function: “What are we trying to do here?”
 - Two-words: active verb + measurable noun
What does it do? What does it do this to?
- Value of a function:

$$Value \approx \frac{Performance}{Cost}$$

Figure 2. Value Engineering for Kids

VE Job Plan

Follow these steps in order:

1. Information: look at what we know
2. Function Analysis: figure out what we're trying to do
3. Creativity: brainstorm ideas
4. Evaluation: choose idea(s)
5. Development: work on idea(s)
6. Presentation: share idea(s)
7. Implementation: make idea(s) into reality

Figure 3. VE Job Plan for Kids

Step 1 - Information

What do we know?

- All the ways we use water (needs)
 - How and why we use water
- Human water cycle
 - Describes the ways people find, transport, use, and dispose of water in order to meet a specific need
- Problems

Figure 4. Information Phase – Human Water Cycle

Step 2 - Function Analysis

What are we trying to do?

- Project Challenge: improve the way people find, transport, use, or dispose of water
- Problem to solve
 - Choose a part of the human water cycle for a need
- Identify functions
 - Use 2-word combinations:
active verb + measurable noun

Figure 5. Function Analysis – Hydrodynamics Project Challenge

Step 3 - Creativity

Brainstorm ideas

- What are current solutions?
- Why does the problem still exist?
- Design an innovative solution that adds value by
 - Improving something that already exists
 - Using something that exists in a new way
 - Inventing something totally new
- Don't rule out an idea just because it seems simple
- Think big
- How might joining forces with others help?
- Human factors

Figure 6. Creativity – Brainstorming Solutions to Human Water Cycle Problems

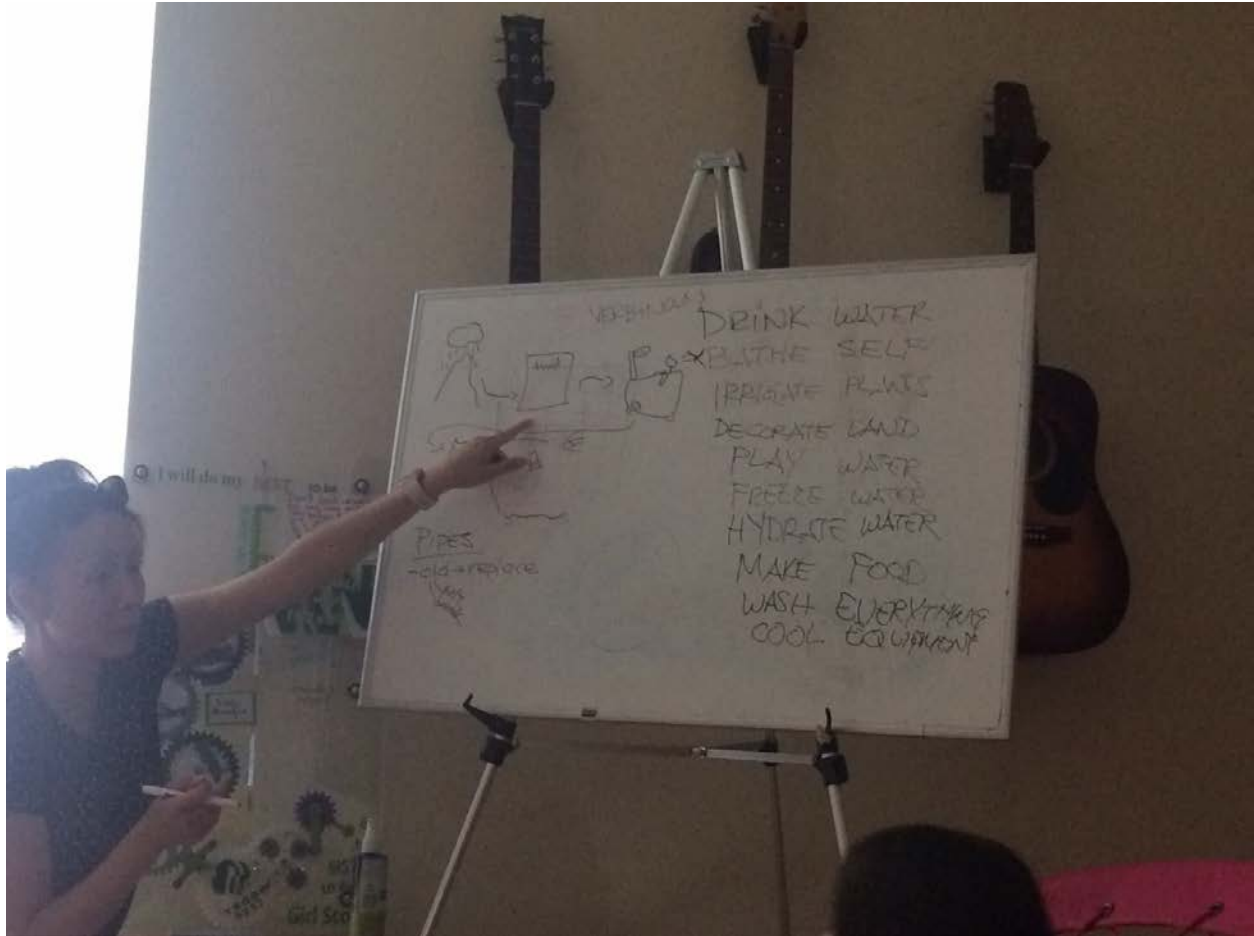


Figure 7. Function Analysis of Human Water Cycle (Photo Credit: Girl Scout Troop #3213)

The resulting conceptual design: “Tub to Grow,” a conveyance system for grandparents to irrigate their garden with bathwater without having to carry pails of water downstairs and outside. The Weirdbots placed ninth place in the FLL competition, evaluated on their core values poster, project presentation, and robot game mission performance.

BENEFITS

By exposing primary through high school learners to VM, the cultural revolution for which the value industry has been looking can be achieved: a corporate culture in which VE is a desire, a valuable resource (Kasi, 2017). This is a solution to the “big challenge for SAVE International” identified by Bethany in her September 2017 President’s Message: “how do we get the decision makers in the upper levels of a wide variety of organizations to become excited about how the Value Methodology can assist them. Because quite frankly without that kind of excitement, the use of the Value Methodology will continue to decline.”

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