Tower Design as a STEAM Project

Judith A. Bazler
Monmouth University, USA

EXECUTIVE SUMMARY

The next generation science standards promote the teaching of engineering skills including the designing, testing and building of models. Tower building can provide a real world experience that not only provides the students with physics and mathematics through motion and stability but the explanation of the use of models and the engineering practice of design, redesign and testing of these models. Tia Pilskow (2014) used the project of building a tower with her middle school students in order to provide a cooperative team long term project. She focused first on the design using background information on existing towers. She required each team to design their tower first using graph paper and scale. This process stressed the need for Art and Mathematics in the STEAM project. The science, technology and engineering also played a major part in the design. The case included in this article expands her process by including a cost analysis attempting to promote real world engineering.

INTRODUCTION

Designing and building a tower project provides students with all aspects of the STEAM process. The physics of force and motion combine with the affects of earth movement, wind, and other geological factors; plus, the mathematical calculations affect the design and structural integrity of the tower. The history of towers, including the newest and largest structures, may motivate students to proceed on a fascinating journey that perhaps trends back to the pyramids then fast forwards to

the Burj Khalifa. This journey also provides the student with historical and present engineering role models and information concerning their interests and their passion for this art form.

The approach of researching past and present structures complete with the research of the scientific and mathematical foundations before the design and before the actual activity is the basis for this lesson's STEAM approach to learning. All disciplines combine to develop the problem and to formalize a new solution. The building and testing and redesigning not only strengthen the process but stress the importance of the research process.

This approach varies from past practice by embracing the research process and the STEAM philosophy. This chapter provides the practitioner with a sampling of the history of a number of towers with suggestions for further research. The history intertwined with science, mathematics, and engineering provides the foundation needed to proceed to design and redesign. The actual activity leads the student into the building and testing which automatically forces the student back to the design. Learner Outcomes complete with possible assessments for this project are:

The students will:

- Practice structural design, model development and engineering, assessed by their designs, their models, and their redesigns.
- Focus on motion and stability, assessed by observation questions and applied design.
- Use mathematics and computational thinking, assessed by observation questions and applied design.
- Explain the use of models in writing, assessed by observation questions.
- Research towers globally, assessed by observation questions.
- Interact in teams, assessed by teacher informally and by observation questions.

Standards

Next Generation Science Standards

Dimension I: Scientific and Engineering Practices (1,2,3,4,5,6,7,8) including asking questions and defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational thinking, constructing explanations and designing solutions, engaging in argument from evidence, and obtaining, evaluating, and communicating information.

Dimension II: Crosscutting Concepts (2, 3, 4, 6, 7) including cause and effect: mechanism and explanation, scale, proportion, and quantity, systems and