

Survey of K-12 Engineering-oriented Student Competitions

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Since college-level engineering competitions have a significant positive impact on students [1], primary and secondary level engineering-related competitions probably also have significant impact. The goals of these competitions include: 1. Encourage students to consider an engineering career, 2. Motivate students to take mathematics and science courses, and 3. Increase students' technological literacy. This paper samples engineering-related competitions in primary and secondary education in the USA and discusses the benefits of these competitions.

A web search identified over fifty regional and national engineering-related (including some science and mathematics) competitions for primary and/or secondary students in the USA. Popular competitions include various robotic competitions (e.g., FIRST Robotics Competition, and Best Robotics), bridge design (e.g., West Point Bridge Design Contest [2]), space exploration, Future City Competition, original research (e.g., Intel International Science and Engineering Fair), and national tests (e.g., Mathcounts, Univ. Colorado HS Programming Contest, and Rio Hondo College HS Drafting/CAD/GIS Technical Competition). Prizes range from a certificate or plaque to \$100,000 scholarships. Approximately 1/3 of the competitions were for individuals, 1/3 for either teams or individuals, and 1/3 for teams. Entry fees range from no charge to \$5000 per team. Judging may require evaluation of a handful of entries to the over 77,000 unique bridge designs submitted to the West Point Bridge Design Contest in 2003, which were judged by a computer program [2]. Roughly half of the competitions involve paper/computer designs or tests while roughly half involve building something (e.g., a robot) to complete a task.

Robotics is the most popular subject for competitions – more than 25% of competitions have at least one sub-contest involving robots. The size of some competitions is evident from FIRST, which involves three levels of robotic competitions: FIRST Robotics, Lego League and Vex Competition. FIRST involved over 14,000 volunteer mentors, over 5000 event and committee volunteers, and engaged over 50,000 students. The keys to winning competitions requiring that something be built appear to be the availability of enthusiastic mentors and of sufficient resources. FIRST participants and mentors reported students improved their communication skills and increased their understanding of teamwork and the role of science and technology in society [3]. Although a very high percentage of graduates (>40%) major in engineering in college [3], it is unclear if they joined FIRST because of this interest or became interested because of participation in the FIRST competition.

1. Wankat, P. C., "Undergraduate Student Competitions," *J Engr. Educ.*, 94(3), (in press) (July 2005).
 2. Ressler, S. J. and E. K. Ressler, "Using a Nationwide Internet-Based Bridge Design Contest as a Vehicle for Engineering Outreach," *J Engr. Educ.*, 93(2), 117-128 (April 2004).
 3. "Impact of FIRST Robotic Competition" at <http://www.usfirst.org/about/impact.htm> (accessed 1 June 2005).
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