

Who Wants to Be an Engineer?

David L. Silverstein
University of Kentucky

Abstract

One of the roles of engineering faculty is to make engineering accessible and exciting to young people. At the University of Kentucky Extended Campus Program at Paducah, we have developed a simple way to reach young people from elementary through high school (and their parents). A simple trivia game modeled after a popular television show has been used for several years to rave reviews from participants. What some of the participants see as a mere game is actually a means of demonstrating the relevance of their science and math education to future careers. The prizes they earn by correctly answering questions give them a taste of the material rewards that may be earned through an engineering career. Above all, this activity ensures that participants have a good time as they are exposed to engineering concepts a direct and entertaining way. The student and faculty involvement in the development of the software used in this outreach, the forums in which it has been used, and the responses of participants are described. Applications of the software in chemical engineering courses are considered. Different modes of question writing are also discussed, including application of the lower levels of Bloom's Taxonomy.

I. Introduction

One of the roles of engineering educators is to make engineering accessible and exciting to young people. At the University of Kentucky, College of Engineering Extended Campus Program at Paducah, we have found a simple way to reach young people and their parents from elementary through high school and beyond. A simple trivia game modeled after the popular television show "Who Wants to be a Millionaire?" has been adapted for use in a classroom setting. The activity, "Who Wants to be an Engineer?", had its debut at the first Engineer's Day Open House in Paducah on February 26, 2000, at the campus of the UK program in Paducah (UKP). A steady stream of enthusiastic contestants and a full house of spectators greeted the activity. Repeat offerings at subsequent open houses have been comparably well received. The program has also been used in recruiting activities both in Paducah and college-wide.

II. Origin

The University of Kentucky College of Engineering Extended Campus Programs at Paducah is a six year-old engineering program offering four-year B.S. degrees in Chemical and Mechanical Engineering. The college developed the program in response to the needs of western Kentucky residents and industry for a regional source of engineering education. Both degree programs are

fully part of their University of Kentucky home departments, with four on-site faculty for each program. In collaboration with Paducah Community College (PCC), which offers the core liberal arts and science courses, and Murray State University, which offers the advanced science and common engineering courses, the University of Kentucky awards the degree. PCC hosts the program in a building specifically constructed for the engineering program.^{1,2}

In 1999, the program began preparing to host its first Engineer's Day Open House in conjunction with National Engineers Week. During this time, the highest rated television program was an ABC network game show called "Who Wants to Be a Millionaire?". On this program, contestants respond to a series of trivia questions of increasing difficulty and have the opportunity to select a correct answer from amongst four possible answers. Correct answers are awarded with cash prizes, beginning at \$100 and increasing to \$1 million.³

The likelihood of near-universal familiarity of the game by the public likely to visit during our open house led to a proposal to develop a game based on the format of the television show. Designed to meet several criteria, the game would be entertaining to a chronologically diverse audience, would be relevant to engineering and engineering education, and could be produced using available resources.

III. Development

The student chapter of the American Institute of Chemical Engineers facilitated the development of the activity. The activity, conducted in a large lecture hall on the PCC campus, utilized a computer attached to an LCD projector. Microsoft PowerPoint was selected as the software platform due to its immediate availability and potential to display attractive and highly formatted text and graphics, and also for its animation and multimedia capabilities. Some consideration was given to implementing game features with VBA scripting within PowerPoint, but simplicity in design was favored in light of the short time available to prepare the activity.

The most labor-intensive task to prepare the activity was preparing a question set for use in the game. All questions selected were to be related to engineering in some way: mathematics, science, and history were three specific subject areas suggested to question writers. Students, faculty, and staff prepared sets of questions of varying difficulty for each of three grade levels: K-5, 6-8, and 9-12. Student organizers categorized, proofed, and validated questions and answers. This process resulted in seven complete games of five questions each were prepared for each of the three grade levels, for a total of 105 questions.

A series of PowerPoint slides displayed the questions. A single PowerPoint file contained a five question round of questions, with the incorporation of both title animations and sound effects. The final size of the file for a single round was just over seven megabytes.

The last element required before deploying the activity was an exuberant master of ceremonies to conduct the game and make it entertaining. A student volunteer agreed to handle the first one-

hour session, and the Paducah program's director of student services handled the other session. Another student and a faculty member facilitated game play by operating the computer.

The rigidity of the game structure required by the use of PowerPoint slides led to the development of a stand-alone application to handle the game. A Visual Basic application was developed by David Silverstein, with questions stored in a database. The program handles all elements of the game including random question selection, determining correctness of answers, and tracking results. It is available for free download.⁴

IV. Deployment

The first Engineers Day Open House held at the University of Kentucky program in Paducah was well received by the community. Over 200 people took the time to register their attendance. Representing about 50 schools in Western Kentucky, Eastern Missouri, and Southern Illinois, 100 students from the area registered to play Who Wants to be an Engineer.

Student members of AIChE chose contestants at random from registrants in each of three grade levels: elementary; middle school; and high school and above. The host asked each contestant a series of five questions. If they answered a question correctly, they had the opportunity to select a prize from the pool corresponding to the difficulty of the question. If the contestant answered incorrectly, they received no prize but moved on to the next question. At any one point in the game, a contestant could use one of two "Engineer's Aides"—either removing two of the incorrect answers from the set of four choices or asking for the audience to be polled for what they believed to be the correct answer. The audience responded to the polling by acclamation as the host read each possible answer.

Representatives from area industry provided numerous items of varying value for use during the game. Contestants answering the first question correctly, for example, would win a University of Kentucky pen and pad set. Those answering the third question correctly might choose a promotionally labeled insulated lunch bag. Those answering the fifth question correctly had various high quality shirts, gym bags, and other premium promotional items from which to choose.

During both one-hour sessions, the auditorium was filled with an audience that stayed for most of the session. There was excellent response to the interaction of the host with the players and with the audience as a whole. The only complaint communicated with the authors was that more people did not have a chance to participate. In total, twenty-one people participated.

The activity was used again during tours from area elementary school students. The students perceived the opportunity to play the game as one of the highlights of their tour. The prize material and literature they took with them from the game should reinforce a positive image of engineering.

V. Refinement

In response to the feedback from Engineering Day 2000, some modifications were made to the activity. The number of questions per round was reduced to three in order to increase the number of opportunities for participation. The stand-alone application simplified the execution of the game and improved the overall experience. The database of questions allowed greater flexibility with editing and entry. To rapidly expand the pool of questions, the students in the freshman introductory courses in engineering have developed question sets as homework assignments.

The first use of the stand alone program with the three-question format was during Engineering Day 2001, and it has been used at all open houses since. It is also incorporated into the College of Engineering's recruiting activities. Surprisingly, the activity has maintained its popularity even as its television namesake has faded.

Assessment performed by interviews conducted with each participant in the game in 2001 indicated that the goals of the activity were met. Students were more likely to consider engineering as a profession after participating in the activity than before. Perhaps most importantly, students had fun playing and had a more favorable impression of the engineering profession.

The first generation of questions consisted of simple fact recitation questions and elementary mathematical calculations. The difficulty of questions was assigned subjectively by the students preparing the database. Use of previously published questions was avoided due to potential copyright conflicts. Figures 1-4 illustrate typical questions and game screens shown during the activity.

The program has also been used in chemical engineering classes as a means of drilling students on basic facts. The competitive nature of the activity motivates students in certain classes. In other classes, however, students have disliked the activity, preferring additional problem examples be worked in class.

A newer method of constructing questions is being applied for future databases. It is proposed that difficulty correspond to rungs on Bloom's Taxonomy of learning. The first question would be a "knowledge" based question, requiring recitation of facts as required by most of the current question set. The second question would be "comprehension" based, requiring differentiation of similar responses, or other questions designed to test understanding of a concept. The final question would be "application" or "analysis", requiring calculation or pattern identification.⁵ It would be inappropriate to expect younger students to go beyond these lower rungs on the taxonomy.

Summary

An activity to engage students in considering engineering as a profession has been developed and made available to the public. Based on a television game show, “Who Wants to be an Engineer” gives faculty a method of using an entertaining medium to recruit students, engage students, and when applied to the classroom environment, test students. Its most effective role to date has been at the University of Kentucky’s Engineering Open House in Paducah, held each February during Engineer’s Week. A mode of developing questions considering Bloom’s taxonomy is proposed.

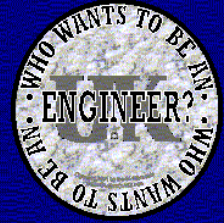
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4. URL: <http://www.engr.uky.edu/~silverdl/wwtbe/index.html>; Who Wants to be an Engineer download
5. Bloom, B.S. (Ed.) (1956) Taxonomy of educational objectives: The classification of educational goals: Handbook I, cognitive domain. New York ; Toronto: Longmans, Green.

DAVID L. SILVERSTEIN

David L. Silverstein is currently an Assistant Professor of Chemical and Materials Engineering at the University of Kentucky College of Engineering Extended Campus Programs in Paducah. He received his B.S.Ch.E. from the University of Alabama in Tuscaloosa, Alabama; and his M.S. and Ph.D in Chemical Engineering from Vanderbilt University in Nashville, Tennessee. Silverstein is also a P.E. licensed in Kentucky. He has over twenty years experience in microcomputer programming, most recently in development of a prototype automatic custom videotape editing and production device. In addition to teaching and research in interfacial phenomena, Dr. Silverstein is developing a computer framework for applying teaching styles to a multimedia computer based supplement to engineering courses.

The formula for the volume of a box is?



- A)** length* height **B)** side²
C) length* width* height **D)** 1/2 base* height

1

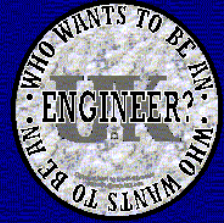
2

3

Audience
Poll
Junior High

Figure 1. A middle school question of medium difficulty answered incorrectly. Notice the correct answer is highlighted green, and the prize eligibility is tracked on the right of the screen. The current level, prize status, current question, and audience poll availability is always on screen.

Who made the accidental discovery of vulcanized rubber?



1

A) Michelin

B) Goodyear

2

C) Cooper

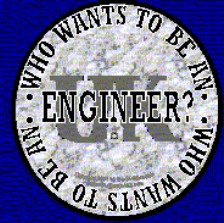
D) Firestone

3

Audience
Poll
High School

Figure 2. A more challenging final question in the high school group. The revelation of the correct answer is pending the contestant choosing a “final answer.”

Orange juice is an excellent source of which vitamin:



A) D

B) E

C) C

D) A

1

2

3

Audience
Poll
Elementary

Figure 3. An elementary level third question, answered correctly. Making certain the difficulty of questions corresponds to the age group is the most challenging part of the game design.

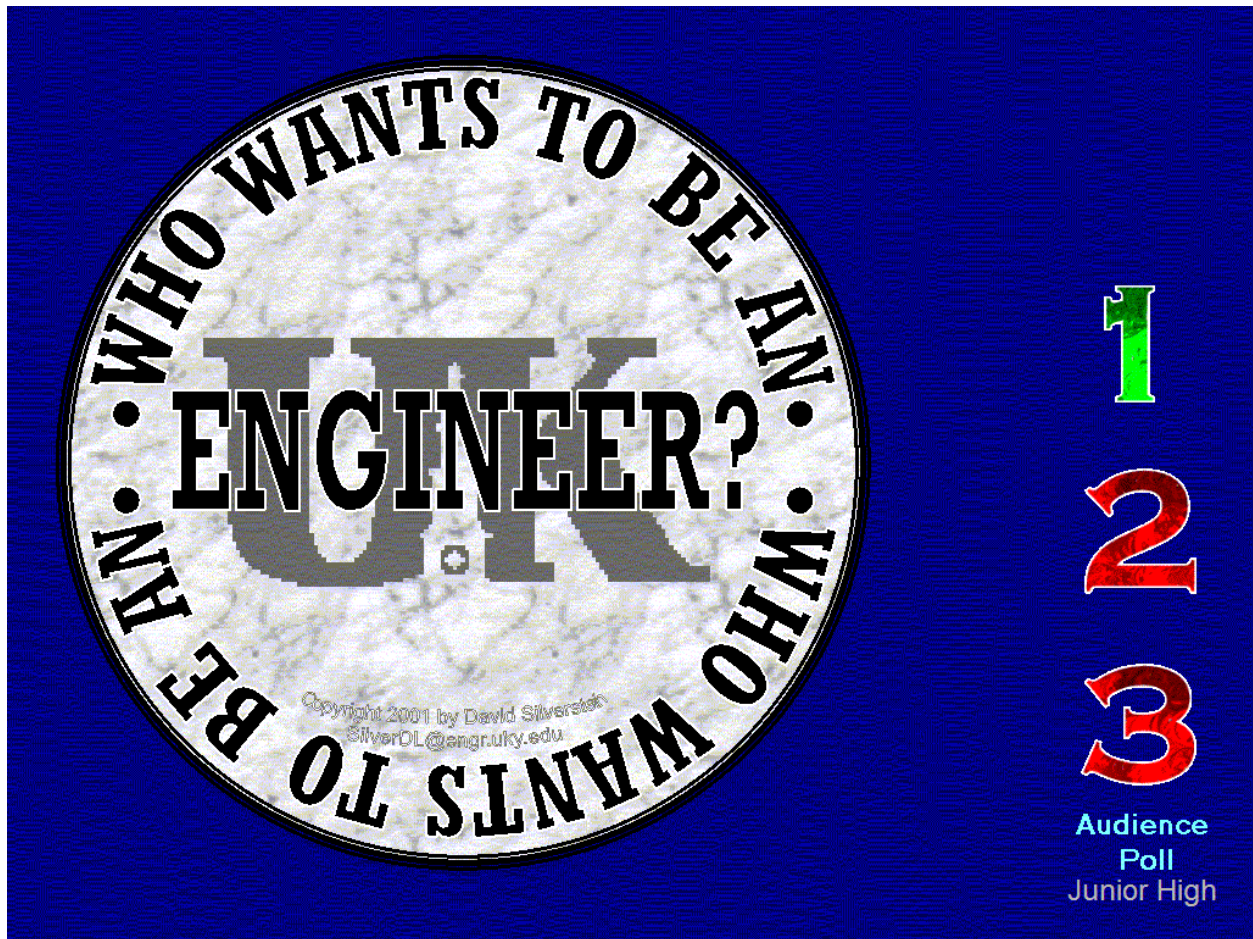


Figure 4. The title screen between rounds ensures that the prize distribution can be handled accurately while a new contestant is called for from the audience.