Computer Science Workshops from the Villanova Magic School Science Camp

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Statement of Topic

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Significance and Relevance of the Topic

This poster describes Computer Science workshops that have been developed and used over three years of a successful service learning summer program that combines elements of computer science, and other sciences, within a theatre-based context. The program is called the "Science and Theatre Magic (STM) Program," and was created in the Department of Computing Sciences at Villanova University, and involves an interdisciplinary team of faculty from across the science and engineering disciplines, as well as undergraduate majors in Computer Science. [3,6,9]

The goal of the program is to increase interest and participation in the sciences (including computer science) at all educational levels, leveraging the positive allure of theatre and magical illusion to create an interactive and enthusiastic science experience for all involved. A major objective is to bring this positive experience in the sciences to inner-city children who might not otherwise envision science as a possible career path, the program is broad in its educational-level scope.

Program Design

Each iteration of the program revolves around the development by teen participants, under the mentorship of a multidisciplinary team of faculty and undergraduate students, of a Harry Potter-esque [7] magic school at which science is taught to inner-city children in an interactive and magical way, with the goal of creating a positive draw to the sciences (including computer science). With a foundation of several computer science elements, the program involves extensive collaboration among science and theatre faculty and a number of outside organizations.

The STM Program makes use of active-learning and inquiry-inspired teaching, starting with providing the raw science, theatre and magic information to the teen participants through a series of brief lectures and hands-on workshops. Under faculty guidance, teens then build their own magically-themed science lessons, as part of an overarching magic school theme, to perform for and instruct visiting elementary-aged youth who attend one of a sequence of single day programs. This approach of balancing science content with a compelling and enjoyable presentation [2], making use of older students to teach younger ones [1], all under the thoughtful guidance of knowledgeable mentors [4] is supported by research.

The educational benefits we have seen in three years of holding this program have been overwhelmingly positive for all involved. Faculty who never had an opportunity for multidisciplinary collaboration and teaching now see the clear relevance of the approach and are actively giving of their time and talents. High school students who come to the program with a narrow focus on a specific science or an interest only in theatre, find themselves unexpectedly excited about disciplines and ideas they never thought of before. The youth who attend the single day programs come not really knowing what to expect, and leave with an increased interest in, and reduced uncertainty about, science, as our follow-up studies have indicated [5].

The combination of service-learning, theatre techniques, magical themes have proved to be a very effective technique. Perhaps the real magic of the success of our program is captured by the well-known quote from anthropologist Arthur C. Clarke, who states that "Any sufficiently advanced technology is indistinguishable from magic." Our program reverse Clarke's logic to support the notion that any sufficiently understood magic reveals the underlying science.

Importance of Computer Science

The use of computer science activities and related technology continue to be foundational to the success of the project. Of all the sciences, computer science is out front in everyday experience, with constant reminders of how reliant on it society has become. Thus, computer science was incorporated as the core science of the STM Program, providing all participants with ample learning opportunities. By gaining a deeper appreciation and understanding of computer science topics, it was hoped that the high school and elementary school students would have a foundation of this crucial science on which to build interests in other science subjects.

Computer Science Workshops

The Computer Science workshops developed for the STM Program cover aspects of HTML coding and basic web page creation, Photoshop graphical design, artificial intelligence chatbot programming, and Alice animations.

The **web design component** of the program teaches the teens the basic HTML tag coding structure and how each one is used in formatting web pages. The teens first attend a mini course and are provided with handouts that give them the required background to get started. The teens then use their new knowledge of HTML to create a web page about themselves as a way to develop some initial web page design experience. These design skills are finally used to create one or more web pages that will be used as part of the STM Program and the magical science lessons that they will perform for the younger children attendees.

The **graphical design component** was based on Photoshop, with students attending lab-style lectures. Photoshop was selected because of its pervasive use in industry and education, and for its ease of use for inexperienced users. After learning about how the Photoshop software works, the teens created the graphical elements they needed for various aspects of the magic school, including logos for printed material, images for web pages, and graphics for use on props and diplomas. Teens also used a scanner to import hand-drawn graphics for resizing, coloring, and other editing within Photoshop.

The **artificial intelligence chatbot component** of the program made use of the Artificial Intelligence Modeling Language (AIML) framework. Programming in AIML enabled the teens to experience something closer to "real" computer programming as they designed semantic pattern matching and response rules. AIML is used to write "chatbot" programs that interact with users via AOL Instant Messaging, many other instant messaging programs, or even from a stand-alone application, based on the semantic rules that are crafted by the programmer. An idea that was developed is the creation of an AI oracle that would answer all magic school (really science) questions given to it. This was a significant challenge, given the time constraints and skill level needed, but a very popular learning module of the STM Program.

The most recently development component makes use of **Alice 3D animation and programming software** [8]. The teens were instructed in the use of Alice 3D animation programming (www.alice.org), focusing initially on drag and drop programming using pre-made 3D models to build blocks of code to run the animations. This instruction began with a brief lecture and guided workshop where teens learned how to program a small animation with a spaceship that lands on the moon and encounters an alien. In a workshop setting teens then developed animations that they could use in the magic school presentations. For example, one team developed a welcoming movie that animated the history of the mythical magic school for the young children attendees.

Content

The poster will consist of a brief description of the STM program, its goals and organization, including an example schedule of how the 3 week program is run. The feature elements of the poster will be diagrams, graphics, photos and other description for each of the four computer science workshops. We believe the specific ideas used for our magic school program can be adapted to computer science instruction in general, and we plan to provide hand-outs to conference attendees with ideas on how to do this. We also plan to have a small video player showing excerpts of the workshops to supplement the material presented on the poster.

Abstract

This poster describes four Computer Science workshops that were developed over three years of a successful service learning summer program run by Computer Science faculty. The program combines elements of Computer Science, and other sciences, within a theatre-based context. Devised by undergraduate Computer Science majors, the workshops instruct teens in website creation, graphical design, AI chatbot programming and Alice 3D animation. These workshops form the heart of the program in which faculty and college students mentor high school students who develop a Harry Potter-esque "magic school" where science is taught to elementary-aged inner-city children in an interactive and magical way.

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