

SIGCSE 2007 Poster Proposal

A Novel Multidisciplinary Service Learning Program with a Computer Science Foundation

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Statement of Topic

A Novel Service Learning Program with a Computer Science Foundation

Significance and Relevance of the Topic

This poster describes two years of a successful service learning summer program that combines elements of computer science, and other sciences, within a theatre-based context. The focus of the program is the development by teen participants, under the mentorship of a multidisciplinary team of faculty and undergraduate students, of a Harry Potter-esque [1] 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.

This Science and Theatre Magic (STM) Program, was developed by a multidisciplinary partnership called Peer Interdisciplinary Volunteer Outreach with Theatre and Science (PIVOTS). The STM Program has been conducted twice as a summer day program in 2005 and 2006, integrating elements of theatre and magic performance into science education, intentionally blurring the distinction between creativity in the sciences and creativity in the arts to remove the initial aversion that some children feel when confronting science subjects.

Educational Foundations

In an inquiry-oriented approach [2, 3, 4], the teacher presents scientific content in a concrete way and designs hands-on activities that give the learner opportunities to be actively engaged, ideally both physically and conceptually (Figure 1). This approach is effective, and requires significant creativity on the part of the instructor to creating appealing lessons.

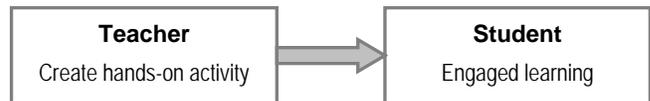


Figure 1. Inquiry based Teaching.

The approach for the STM Program is to formulate activities that use the engaging and quickly grasped story of a day at a school of magic as the unifying theme that can be employed to extend and enrich practically any science lesson. This approach takes students behind the scenes and makes them active participants, not only as consumers of creative science experiences, but also as creators (Figure 2).

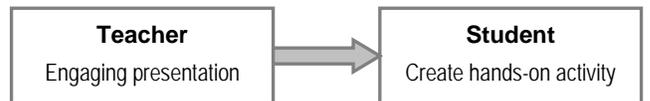


Figure 2. Inquiry inspired teaching.

This approach is similar to science museum exhibits, where creative exhibits make science attractive and accessible to young people. Since these exhibits are primarily passive, this “gee whiz” approach to science can lead to a disengaged, “let’s see what else is cool” attitude which reinforces the presupposition that science is complex and incomprehensible. Research indicates that it is important to balance the emphasis on the technical aspects of science with a compelling picture of the social and multidisciplinary aspects [5], providing a view of science within a context of everyday experience.

Enlisting older children and teens as teachers or mentors for younger children [6] can be successful, although it hinges on the quality of the initial training of the mentors and even more on follow up coaching provided [7]. The approach is extended to faculty mentors, providing multidisciplinary expertise to support the unifying theme of a day of science exploration at the magic school.

Significant Educational Features

Central features that motivate and inform the STM Program are:

Service-learning: Community service provides a way to expose students to the larger context of their education and has demonstrated academic benefits when the service is integrated

with traditional instruction [8, 9, 10], increasing interest in a variety of academic subjects. At the same time, service learning can respond to a community need: As adolescents progress in age, underprivileged minorities are often left behind because of their lack of access to enrichment activities during the summer and after school [11, 12, 13]. On the community level, the demand for quality enrichment activities to supplement neighborhood summer programs, after-school, and latchkey programs is clear. For example, the Philadelphia Department of Recreation runs over 140 low-cost summer camps in the region; children enrolled in these types of activities can benefit from opportunities to visit and take part in innovative educational programs, such as the STM Program, providing experiences that could have a dramatic influence on their futures.

Integration of elements of Theatre: There is substantial evidence that children learn better through direct involvement and hands-on activities that engage many modalities and all of their senses [14]. Drama, storytelling and re-enactment have proved to be powerful forces in education, have a long tradition of successful application to motivate learners and to clarify difficult concepts in humanities education and can have a profound effect in the teaching of science [15].

Magic as a theme: Magic has been found to be a successful technique to engage students and introduce difficult science concepts from a diverse range of subjects, including Physics [16], Chemistry [17], Computer Science [18, 19], Mathematics [20], and for many years as a successful method for improving learning outcomes [21, 22], and for students to learn through teaching others [23]. One of the reasons for the success of magic in education is that it often leads to a perceived discrepancy between observation and firmly held beliefs, a “teachable moment,” which is an effective way to motivate children [14]. By choosing a magic trick that relies on a scientific principle, the teacher can thus motivate the students to want to learn the science that explains the trick (Figure 3). Many excellent collections of science experiments or mathematical games can be used in this manner, such as [24].

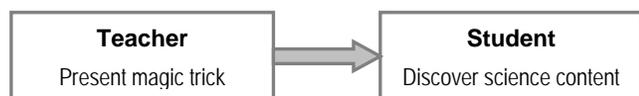


Figure 3. Magic leading to science discovery.

The STM Program seeks to create an effective context for this approach and to also explore the educational benefits of reversing the interplay between magic and science, inspired by the well-known quote from anthropologist Arthur C. Clarke, “Any sufficiently advanced technology is indistinguishable from magic.” Reversed, the outcome of this approach could be that any sufficiently understood magic reveals the underlying science.

Importance of Computer Science

The use of computer science activities and related technology were 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 scholars and apprentices would have a foundation of at least one science on which to build interests in other science subjects.

Scholars studied HTML coding, graphical design (Photoshop) and basic web page design, and developed printed material and a small web site for the magic school that included elements of the other sciences that were studied and presented. Graph Theory and Euler Circuits/Paths were introduced via an interactive play: (“Case of the Stolen Dragon Eggs”). Scholars then reused this approach to craft theatrical presentations of other science concepts. Scholars also explored artificial intelligence by learning about AI and then developing an appropriately wizard-like chatbot using open source Artificial Intelligence Mark-up Language (AIML) software (www.alicebot.org). The chatbot served as the focus of much enthusiasm about the idea of creating and interacting with an artificial computer brain.

Beyond face-to-face interactions, the fundamental medium of communication among scholars and faculty was a web log (“blog”) and (in Summer 2006) a message board, where scholars gathered ideas, exchanged feedback, discussed the project and documented their experience. Faculty provided guidance, ideas and support, creating a true online community in the best, and most educational, sense. The blog and message board provided a real-world, applied context for the computer science ideas that scholars learned, and beyond that, excelled as an organization tool for developing and planning the magic school presentations for all of the sciences.

Content

The poster will consist of a brief description of the program, its goals and organization, an example schedule of how the 3 week program is run, ample photographs of each phase of the service learning experience, background justification linking the significant educational trends with program components, and a summary of the results of a formal assessment. Featured will be the variety of computer science components that serve as a foundation and focal point for the program.

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