Science for Success

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Introduction

The Science for Success program began out of a concern regarding science education in Hillsborough County Schools, particularly at the elementary level. Many teachers were not comfortable with fundamental science concepts, and rarely developed science based lesson plans. Merely reading a story about science was often considered an acceptable science class. Although it was a stated goal of Hillsborough County School District to include science curriculum, the reality fell sadly short of that goal. In addition, many educators were concerned about the introduction of the Florida Comprehensive Assessment Test (FCAT), a new statewide examination used to determine funding levels for schools; better-performing schools received additional funding. Many teachers were removing science from their curriculum in order to concentrate on those subjects directly tested by the FCAT. Finally, it is widely recognized that student interest in science is at a very low level. In order to encourage students to brave the rigors of mathematics, science must be seen as a tantalizing goal, not as a drudgery to be endured; it is particularly important to spur the interest of students at the grade school level[1].

Out of this background, an association was formed. The principal idea motivating this association was to incorporate hands-on science teaching directly into the classroom. It was also recognized that success on the FCAT examination requires advanced higher order thinking skills[2]; at least half of the questions on the FCAT fall into the upper tiers of Bloom's Taxonomy[3]. It was hoped that by emphasizing the logical problem solving skills demanded by the scientific method; by examining in detail the relationships between cause and effect; and that by undergoing the process of hypothesis, data collection, and analysis, students would develop advanced higher order thinking skills. It was our anticipation that the science instruction would have a direct effect on both science achievement and student affect for science. It was additionally anticipated that a secondary effect of the manner in which the program was delivered, and the concentration on higher order thinking skills, would produce an increase in achievement in other areas[4]. Scores on the FCAT were of principal interest to school administration at the time of the program. However, the science component of the FCAT was not scheduled for administration for several more years. Thus, the assessed goals of the program were to increase student interest in science, as well as to boost the scores of the students on the FCAT mathematics, reading, and writing subject areas.

Program Particulars

The Science for Success program was a cooperative venture between the Museum Of Science &

Industry (MOSI), CitiGroup Corporation, and the Hillsborough County School District (HCSD). The program delivered hands-on science lessons, administered by MOSI instructors, at public school classrooms in Tampa, Florida. The lessons were delivered to seven different class groups, spanning grades 3 through 7, at five schools within the HCSD. The schools selected were all Title 1 schools that had received a "D" grade under the Florida school accountability guidelines, indicating a need for significant improvement in the FCAT scores of the students. One-hour classes were delivered on a weekly basis to the same group of students over a one-year period. These students were selected by school administration as "middle-of-the-road" students, and were pulled out of their normal class sessions to participate in the Science for Success program.

Because the FCAT statewide examination is delivered in spring, the program began in spring 2000 following the FCAT examination for the year, working with students in 3rd, 4th, and 7th grades. Following the summer break, the Science for Success program resumed working with the same students, who were then in 4th, 5th, and 8th grades, and continued until the spring of 2001, just prior to the next round of FCAT exams. A total of 209 students began the program, of which 120 completed the entire curriculum. (For details regarding age, gender, and other sampling factors, contact the first author.)

Classroom Environment

The curriculum itself varied over a wide range of topics that were selected by the science education team at MOSI, based upon the hope that they would both spark student interest, as well as being related to everyday activities. Each class typically featured a brief lecture to introduce the basic concepts, followed by a hands-on experiment that allowed the students to see the concepts in action. Over the course of the project, the broad subject areas covered were astronomy, physics, and biology. Specific topics included distance, energy, gravity, electricity, diseases, biological classification, and planetary features. These specific sub-topics were selected primarily because they lent themselves to the development of higher order thinking skills.

It has been noted that there are multiple styles of learning, and that knowledge acquisition is greater when the teaching methods employed make use of multiple learning vectors[5]. To that end, the lessons and activities tried to stimulate as many learning styles as was feasible. Lectures incorporated drawings, diagrams, and vocabulary words. For example, when discussing electricity, the concept of a *circ*uit was tied with that of a *circ*le; root-word connotations such as this were frequently discussed.

The activities also included multiple learning vectors. Students drew diagrams, built machines, and gave theatrical presentations. When introducing the concept of distance, these techniques were incorporated by measuring classroom dimensions in several common (and not so common) units. These units included the foot, the meter, and, much to the delight of the students, the Joe. In the case of energy, students raced cars down slopes of different angles, but the same height. Students were able to see that the toy cars had very similar speeds at the bottom of a ramp, regardless what the slope of the ramp had been; it was the height of the ramp that determined the final speed. At all opportunities, students were asked leading questions prior to conducting the activities; these questions often led to open classroom discussion. The goal of these questions and

discussions was to encourage the students to analyze the expected results of the experiment. Following the activities, students were asked additional open-ended questions about other applications of the core concepts.

Results

Student surveys were delivered to the Science for Success students both early on, and in the final weeks of the program. The results seemed to clearly indicate an increase in student interest in science. In addition, focus groups were conducted with the students in the final weeks of the program. Approximately 10 students were selected from each class and were invited to discuss with the program evaluator what their feelings regarding the program had been. Each set of students met as a group with the program evaluator for a 40 minute guided discussion. All of the students indicated that they had enjoyed learning science in a manner that was at once humorous and applicable; all of them would have been delighted to participate in a similar program again[6]. In particular, many students identified strongly with the instructors who delivered the program. For many students, experiences such as these can be contributing factors in the selection of a career in science [7].

Unfortunately, the achievements results were not so compelling. After the analysis was completed, it was evident that the Science for Success students scored marginally higher than their matched counterparts on almost all test sections. However, none of the deviations were large enough to exceed the 95% confidence band[8]. Thus, we were forced to conclude that the Science for Success program did not raise or lower the score indicators for these middle-of-the-road students. As stated earlier, however, the achievement data available for this analysis (the FCAT mathematics, reading, and writing scores) only allowed for an investigation of the secondary effects of the cognitive impact of the program. It is our belief that had the FCAT science examination been available, the program students would have scored significantly higher than the control students.

Findings

At the end of the program, a careful examination of the past year was conducted, examining all of the triumphs and tribulations in detail. In addition, a list of problem areas that could create difficulties for future groups was developed, as well as ideas for future remedies.

First, communication issues between the program presenters and the schools became a concern. On several occasions the presenters arrived at the school, set up the classroom activities, and then called for the students, only to discover that the students were on a field trip, or in an assembly. During the later half of the program, the program presenters began calling the schools the day before to confirm that the class was still scheduled; this obviously saved considerable effort. Future programs of this nature would do well to develop stronger relations with school administration right from the beginning, however.

Secondly, the program presenters never had a formal opportunity to discuss mutual expectations and standard classroom procedures with the teachers. While it had been hoped the teachers would be involved with the material and presentation, many teachers viewed the Science for Success instruction period as free time. It was not uncommon for teachers to catch up on grading, read books, or (in one notable case) nap. However, those classes in which there were clear expectations and reasonable teacher involvement always seemed to flow better.

Third, the fact that the program operated by pulling out the particular students selected for the Science for Success added to the difficulty. It had been hoped, during program design, that teachers would be able to incorporate some of the subject material into their own lesson plans, thus reinforcing the information and techniques. This proved difficult for a teacher to do, however, when only a handful of their students had been in the Science for Success classroom, and had received any exposure to the material at all. Future programs should work with an entire class (or even grade) thus ensuring that corollary material could be more easily presented.

Continuations

It was hoped that future programs of similar design would fare better if they addressed those three crucial areas identified above: administration support; teacher involvement in the classroom; and corollary instruction that built upon the science lessons[9]. Happily, it was possible to implement many of these crucial points during a later program of similar nature.

The University of South Florida Charter School and the MOSI created a joint program to teach science in the Charter School. The science instruction is primarily the responsibility of one person at MOSI, Tim Hill, who was also involved in the Science for Success program. Tim met with the Charter School teachers before the new program began, clearly outlining mutual goals and expectations. Classroom discipline still remains the province of the teachers, thus reinforcing to the students that they are still in the classroom. Tim works with the teachers about a month in advance of his presentations, both in order to tailor his curriculum to monthly themes at the school, and to help brainstorm for ways to tie the material together into a pervasive teaching plan[10].

Although funding has not been secured for achievement analysis of these new developments, both Tim and the USF Charter School teachers feel confident that their students are developing a firm grasp of science and critical thinking skills. Student affect also seems to be remarkably high in the new program.

Conclusion

The Science for Success program delivered high-quality, hands-on education to over 120 students for an entire academic year. The impact on student affect for science was quite substantial. We anticipate that a standardized science achievement test would have found significant gains. While the program did have difficulties, it our hope that future groups can benefit from these experiences delivering non-traditional science education in the classroom.

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Biographical Information

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