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Bumble Boosters: Students Doing Real Science

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Bumble Boosters: Students Doing Real Science

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Bumble Boosters was a lottery grant funded cooperative project between the University of Nebraska- Lincoln, Department of Entomology, the Lincoln Public Schools, Science Focus Program, and the Lincoln Folsom Children's Zoo. The primary education goal of the project was to create a community of learners to conduct authentic research on bumble bees in Nebraska. Participants were actively engaged in collecting bumble bees and placing nesting domiciles. Internet technology was employed to facilitate networking between project participants. Systematic evaluation was conducted during and after the project.

KEY WORDS: Inquiry, Authentic activities, Technology applications.

BUMBLE BOOSTERS: DOING SCIENCE AS A COMMUNITY OF LEARNERS

The primary goal of the project was to create a community of learners to conduct authentic research on bumble bees in Nebraska, a goal especially consonant with National Science Education Standards (National Academy of Sciences, 1996). A unique aspect of this project was that participating schools from across the state were involved in making important contributions to the knowledge of bumble bee distribution and abundance, the attractiveness of artificial nesting domiciles, and the plant species visited by bumble bees.

INTRODUCTION

In 1992, Nebraska voters approved a constitutional amendment authorizing the creation of a state lottery. The law specified that 25% of lottery proceeds be set aside for innovative educational and environmental projects in Nebraska, and for compulsive gamblers assistance. The official Web site (http://www.nde.state.ne.us/EEC/) includes history of this effort, and includes the statement:

> . . . these funds are not designed for ongoing operations. Instead, they constitute "seed" or "research and development" money, for one-time activities and short-term projects. Where on-going activity is concerned, participation from this funding source should be limited to jump-starting new projects or giving existing projects a boost to propel them to a significantly higher level, with continuation funding coming from other sources.

The statements continue:

> . . . these funds . . . constitute risk capital and strategic assets in search of educational visionaries and entrepreneurs. They are not a slush fund or a pot of reserves for undertaking routine or well-tried projects (no matter how worthy), or for attempting activities that previously have not been found sufficiently cost-effective or high-priority.

From inception through December, 2001, about $75 million were allocated through this source.

The Bumble Boosters project was funded through the Nebraska Lottery's Educational Innovation Fund. Funding for the project began in July 1999 and ended in July 2002. The project

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was initiated by Ellis at the University of Nebraska Department of Entomology who established a partnership with Lincoln Public Schools (LPS) and the Lincoln Folsom Children's Zoo to sponsor the proposal. The LPS science focus program, better known as "Zoo School," is housed on the campus of the Lincoln Folsom Children's Zoo in Lincoln, Nebraska. In recent years, the Children's Zoo has become a seedbed for innovation in K-12 science teaching.

THE PROJECT

Bumble Boosters had both teaching and research goals. The main teaching goal was to engage students in authentic research. The project also sought to increase science-inquiry skills and used technology to support instruction and networking. Two research goals were to determine the distribution and floral preferences of Nebraska bumble bee species. There are 239 species of bumble bees worldwide. Twenty species of bumble bees were reported to occur in Nebraska prior to the project (LaBerge and Webb, 1962). Students in 40 high schools participated in collecting bumble bees in order to find the distribution and floral preferences of species in the state. A concern of participating teachers was the possibility of students being stung by bumble bees. However, bumble bees are only defensive around their nest if disturbed and will not sting unless touched away from their nest. Although thousands of persons participated in this project, not a single sting from a bumble bee was reported.

Another research goal of the project was to investigate artificial domicile designs for attracting bumble bee queens. In the spring, bumble bees emerge from overwintering chambers as solitary queens. After emergence these queens feed and search for a nesting site in which to rear their offspring. Suitable nesting sites are preexisting, protected from the elements and have insulating materials present. In nature, bumble bees nest in abandoned rodent dens, however queens will sometimes choose man-made structures in which to initiate a nest. In previous studies several researchers have tried to create effective artificial domiciles for attracting bumble bee queens but have experienced limited success (Frison, 1926; Fye and Medler, 1954). The lack of success by previous researchers provided students with an opportunity to contribute to our understanding of nesting domicile preferences. Bumble bees pollinate a broad spectrum of floral resources including much of our native flora. They are also economically valuable due to their use as greenhouse pollinators for tomatoes and vine crops.

TEACHING OUTCOMES

The creation of a curriculum and suitable curricular materials was a major undertaking for Bumble Boosters. A systematic evaluation of the project was undertaken by Schlesselman (2002). Participating educators used any of several means to complete Likert-scale and open-ended survey items. Thirty-four respondents (from among 44 potential respondents) replied, and used mail, online, and telephone responding media about equally. Of the responding teachers, 85% indicated that the project would "impact your development of and number of new science projects" Teachers rated "the overall success of [their] experience with the Bumble Boosters project" as 4.04 (on a scale of 1-5). A key-contributing factor to the success of this project was reflected in comments from educators and students. This was a hands-on, investigative project; students were able and required to get out of the classroom and into the field to participate in the investigative process. This generated a great amount of excitement among teachers and students because students were actually engaged in, enjoying, and succeeding in the scientific process.

One teacher found watching her students participate in this project facilitated her in planning other projects with practical applications. Still another teacher spoke of how she could see student confidence building throughout the year as they learned about research and the process of investigation.

One teacher said:

> We didn't know what the results would be like. With all the cookbook projects we do in class ... I have an idea of what's going to happen, and I think they know

> also. They slowed down and took their time. I saw them recording and that was incredible.

The nesting domiciles were of great interest to most students. Many schools made tremendous efforts to construct successful domiciles – experimenting with various building and nesting materials. In one school, science students joined forces with the shop class and built 65 nesting domiciles and spent considerable time painting and placing them.

This particular project caught the eye of the community, and some members of the town also wanted nesting boxes for their yards. Unfortunately, nearly every teacher and student comment indicated that these efforts were largely unsuccessful in attracting and retaining bumble bees, which was quite disappointing. However, students were addressing a real problem, and many scientists have reported similar results.

Many teachers indicated that the work on this project eased the transition of inquiry into other areas of insect biology, ecology, and other science curricula by creating a cooperative and interesting investigative process. This opened the doors to asking questions and applying the learning techniques to other topics.

The technology component for facilitating networking and information sharing was the least successful component of the project. This was mainly due to the lack of computer resources available to educators and students in most schools and not the quality of the resources. The ratings placed using web pages for learning and sharing of information at 3.54 (SD = 0.99) out of 5.0. Networking to solve shared problems (via computer and otherwise) received a similar rating of 3.52 (SD = 1.37) out of 5.0. Everyone who used the web site (http://bumbleboosters.unl.edu/) found it to be informative and helpful, but the site was not heavily used – as found per discussions with educators and survey results. Most teachers, especially in smaller communities, have limited computer availability and access. A few of the educators did not use email, thus communicating electronically for them was not an option. Most of the educators were able to access the online discussion list that was available for part of the project, and found that it was very useful during the first year of the project.

Students found that the main uses for the web site were to use the bumble bee identification guide pages, to read about their school and other partner schools, and to follow any data that had been posted on the site regarding collection information. Some educators indicated that viewing the Bumble Boosters web site was their only source of "networking" with other schools in the project.

A focus on networking increased as the project progressed. For many students, actual networking became a function of forming groups within classes – with the project often becoming a social opportunity for students to work with others in their classes. Some educators described the Bumble Boosters project as a good team-building process for students, especially in the artificial domicile and bee collecting activities of the project. One teacher indicated that this was the first time for some of his students to actually work together.

One advantage of the Bumble Boosters web site, as indicated by many educators, is that it has been a stable and constant source of information for future projects. It contains information on resource kits, a key to Nebraska bumble bee species, links to other web sites, and selected references. It also serves as a template for projects wanting to incorporate similar web page design. Because of the international availability of the web, the site can be viewed by anyone with Internet access. Project coordinators shifted the primary focus of the web site after the first few months from facilitating networking to supporting the informational and educational materials of the project. The shift in focus was implemented when a variety of constraints for teachers regarding computer availability and access emerged. There were issues with the technical capability to view the web site on some computers. The design team made the web site very easy to use for those with limited computer capabilities.

Though geared toward high school students, the Bumble Boosters project impacted thousands of people including: students of all ages,

educators, parents, senior citizens, community members, and youth groups.

RESEARCH OUTCOMES

Student-collected bumble bees greatly expanded the known range for most species. Over 3,200 bumble bees were collected and identified. Students also recorded host plants visited by each species, and a list of plant species for attracting bumble bees is being prepared for distribution.

Although none of the student-created domiciles were attractive to bumble bees, many scientists have experienced similar results. Unlike typical high school science experiments, this project, like the real world, had the possibility of failure. Students learned that scientific discovery requires hard work, diligence, and building on what others have learned.

A single specimen of a species not previously reported in Nebraska was also collected, however, project leaders were not successful in collecting the species again the following year. Nevertheless, the site will continue to be monitored by project leaders and the species will be added to the list of Nebraska species if recollected.

CONCLUSIONS

The goal of Nebraskans at the time of their support for legalized gambling was to support worthy projects that otherwise would not be possible. The intent of this brief paper is to afford readers a specific example of an innovative science project that was initiated by such funding. At the time of preparation of this manuscript, all revenues in Nebraska generated from gambling sources have been redirected to general obligation funds.

References

Frison, T. H. (1926). Experiments in attracting bumble bee queens to artificial domiciles. *Journal of Economic Entomology* 19: 149-55.

Fye, R. E., and Medler, J. T. (1954). Field domiciles for bumble bees. *Journal of Economic Entomology* 47(4): 672-676.

LaBerge, W. E., and Webb, M. C (1962). The bumble bees of Nebraska. *Research Bulletin*, No. 205, University of Nebraska College of Agriculture, Agricultural Experiment Station, 33 p.

National Academy of Sciences (1996). *National Science Education Standards*, National Academy Press, Washington, D.C.

Schlesselman, D. (2002). *Bumble Boosters: Doing Science as a Community of Learners: A Project Evaluation*, Center for Curriculum and Instruction, University of Nebraska - Lincoln, Lincoln, Neb., p. 53.