Results of a Survey Assessing the Impact of Astronomy Village: Investigating the Universe

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Abstract

This paper discusses the results of a follow-up questionnaire administered to over 300 registered owners of *Astronomy Village®: Investigating the Universe*™. The results indicate that teachers who used the software were very pleased with it. They felt that students were learning a variety of science related skills. It was also determined that the greatest barriers teachers face in adopting *Astronomy Village* are lack of proper equipment and lack of time.

Introduction

In March 1996 the NASA Classroom of the Future (COTF) pressed 13,000 copies of *Astronomy Village®: Investigating the Universe*™. The software was distributed to teachers, free of charge, through the NASA Educator Resource Network (ERC). Teachers who returned their registration cards were entered into a registered owner database.

Astronomy Village is part of COTF's core mission to provide high-quality multimedia that enables students to investigate important scientific problems facing NASA. This particular software presents students with an interface to a virtual observatory village, from which they may select among 10 contemporary astronomy problems for investigation. Students are guided by a video-based virtual mentor, who helps them engage in the steps of scientific inquiry: background reading, data collection, data analysis, and data interpretation. After completing an investigation, students face a virtual press corps that queries them about their research.

During the months of May and June1997, questionnaires were sent to approximately 350 registered owners of *Astronomy Village®: Investigating the Universe*™. The purpose of the survey was to begin tracking the software's impact on the education community.

The 80 responses to the survey (23%) provided information about the typical teacher, course profile, the benefits to students using the software, how many teachers had attended training sessions, and the barriers to implementing the software. This report summarizes the results of that survey.

Astronomy Village Users

Of the 80 teachers who responded, only half had actually used or were planning to use *Astronomy Village*. These teachers were labeled "users." The "nonusers" were those who had no plans to use the product. Within the user group, a typical teacher was a white male, age 46, with an education at the master's level who taught at a public, suburban high school with an enrollment of 3,200 students. Science classes at his school met for approximately 45-50 minutes, five times a week. There were an average of 26 Macintosh computers available to him during class time.

The average grade level for the *Astronomy Village* student was ninth grade. Sixty-five percent of *Astronomy Village* students were in high school, and 35% were in middle school. There were roughly equal numbers of boys (48%) and girls (52%). Most of the students were enrolled in a semester-long astronomy course (44%). Teachers also used *Astronomy Village* in Earth science (26%) and general science courses (13%). Students in the typical *Astronomy Village* classroom were of mixed abilities. Most students in the typical *Astronomy Village* classroom were Caucasian, followed by Hispanic and African American (see Table 1).

RACE	Caucasian	Hispanic	African American	Asian or Pacific Islander	American Indian or Alaskan Native
Percent of AV Students	70%	20%	6%	3.6%	.47%

Table 1: Percent of *Astronomy Village* students in each ethnic background.

The 40 respondents who used *Astronomy Village* during the 1996-97 school year exposed 2,567 students to the software. If these data are representative of the population of 350 registered owners, the number of students actually exposed to the software is around 11,000. We estimated that there are an additional 750 unregistered teachers who received a copy of the *Astronomy Village*. If the survey respondents are representative of all teachers who have copies of *Astronomy Village*, approximately 600 teachers have exposed 37,000 students to *Astronomy Village* during the 1996-97 school year.

Student Benefits

Based on responses to open-ended survey questions, teachers reported that through experience with a variety of technical tools students began to demonstrate learning abilities in the areas of academic motivation, cooperative learning, research experience, creativity, and self-regulated learning.

Experience with Technology. *Astronomy Village* offers opportunities for students to use technology. “They used many tools of technology to find answers to their questions.” A representative comment described *Astronomy Village* as a “fantastic storehouse of information.” Teachers also felt that *Astronomy Village* was easy to use, unlike other CD-ROM programs; therefore, time was not wasted on technical instruction.

Academic Motivation. Many teachers found *Astronomy Village* to be highly motivating for students partly because the students could choose which investigations they wanted to pursue. Researchers report that allowing students to choose heightens enjoyment and task involvement, which lead to greater student learning (Cordova & Lepper, 1996; Dev, 1997; Harackiewicz & Elliot, 1993). One representative comment described *Astronomy Village* as “very interesting, and kept students engaged.”

Cooperative Learning. *Astronomy Village* is designed so that students can perform investigations while working in cooperative groups. Cooperative learning involves social interaction that “can exert positive effects on students’ motivation to learn, on their self-esteem, and on the students’ perception of their classroom environment as well” (Sharan, 1980; Slavin, 1983). Most of the teachers who responded to our survey reported that their students worked in cooperative groups while using *Astronomy Village*.

Authentic Research Experience. The investigative pathways in *Astronomy Village* were designed to present problems in contemporary astronomy. One representative teacher wrote, “Every day there was news from the daily papers to discuss in class in relation to investigations." Teachers felt that the software tools in *Astronomy Village* replicated how a variety of resources are needed for scientific investigations. Teachers also believed the software helped students become critical thinkers, a quality necessary for scientific research.

Creativity. Teachers reported that *Astronomy Village* promoted creativity. This may have been because the investigations contain new information about which the students have little or no prior knowledge. Creative intelligence is necessary to successfully perform novel tasks (Sternberg, 1988). The investigations push the students to find the answers to unfamiliar problems, causing them to have to think creatively.

Self-Regulated Learning. Teachers reported that students engaged in self-regulated learning. Some teachers reported that students were able to guide themselves through the investigations. By guiding themselves, students were able to monitor their learning. "Monitoring is the cognitive process that assesses states of progress relative to goals, and generates feedback that can guide further action" (Butler &Winne, 1995). One teacher stated that the software "lets [students] control their learning."

Teacher and Student Satisfaction

Both the users and non-users of *Astronomy Village* were asked to rate the quality of the materials. Overall, the teachers rated the quality of the materials very highly. One teacher explained that even though the material was difficult for his eighth-grade students (*Astronomy Village* is designed for high school students), they still enjoyed the opportunity. He wrote, "[They] can't wait for a middle school version." Another teacher reported that his students loved the program. The same teacher wrote, "I have a sixth grader who plans on being an astrophysicist. He wanted to do all the investigations."

Barriers to Using *Astronomy Village*

The typical respondent who indicated they had not and would not be using *Astronomy Village* was very similar to the typical user, with the exception of the grade level they taught and their access to technology hardware. The typical nonuser was a white male, age 48, with an education at the master's level and taught at a public, suburban middle school with an enrollment of 1,400 students. Science classes met for approximately 45-50 minutes, five times a week. There was an average of 7 Macintosh computers available to these teachers during class time.

The average grade level for nonusing students was eighth grade. Overall, there was a larger percentage of students in middle school (69%) than in high school (31%). There were roughly equal numbers of boys (47%) and girls (53%). Most of the students were enrolled in a year-long astronomy course (33%). Non-user teachers also taught Earth science (22%) and general science courses (17%). There was a significant number of teachers from nonscience courses (14%) such as math, social science, and reading.

The nonuser teachers were asked to provide reasons for not using *Astronomy Village*. The two main reasons were lack of hardware and lack of time. These answers are consistent with the findings of a U.S. Department of Education report on *Teachers and Technology*. The nonuser teachers stated that lack of technology was a significant barrier. They had an average of only 7 available computers, whereas the user population had an average of 26 available computers.

Training

The majority of survey respondents, both users and nonusers, represented a highly trained group of teacher leaders. They frequently attended national and state professional meetings, attended and conducted inservice workshops, and served on curriculum committees.

There were no differences between users and nonusers in the proportion of teachers who had received training on *Astronomy Village*. Roughly one-third of the teachers had received training. Only two had received training directly from COTF. The remaining teachers had received training at national, state, and local workshops.

Of the 24 respondents who received training, 5 indicated they had also conducted training sessions on *Astronomy Village*. There were 4 teachers who had not received training yet who had offered training. The teachers who offered training represented 11% of the registered owners. If our sample is representative of the entire population, then we can predict that for every 100 trained teachers who receive a copy of *Astronomy Village*, we will reach approximately 800 additional teachers.

Discussion

The results of this survey indicate that the NASA Classroom of the Future has been successful with the development and dissemination of *Astronomy Village.* Through NASA's ERC network, *Astronomy Village* has been distributed to thousands of teachers, with the potential of reaching tens of thousands of students each year. The teachers indicated that the materials are of high quality and lead to effective learning outcomes in the areas of content knowledge, technical skill, and attitude towards science.

The survey uncovered a few barriers that teachers have faced in trying to implement *Astronomy Village*. These barriers are not unique to *Astronomy Village*, however. According to the Department of Education, they are endemic to all educational technology projects.

First, teachers work in schools that lack the necessary hardware. (Because *Astronomy Village* represents an excellent example of effective technology, it can be used as a lever for change—to convince teachers' school boards to buy the equipment necessary to run programs like *Astronomy Village*. Several teachers, such as Teresa Wiltse at Northwest High School in Jackson, MI, used our product in just that way.)

A second barrier teachers faced in using *Astronomy Village* was inadequate time to plan a strategy for implementing the open-learning investigations. This problem could be remedied by a revised *Astronomy Village Teachers' Guide.* It should contain a quickstart guide, a content overview, more direct links to the content in the National Standards, suggestions for integrating *Astronomy Village* into a variety of courses, and suggestions for using the software with a variety of computer configurations—from a one-computer classroom to a thirty-computer classroom.

If used effectively, *Astronomy Village* can help produce scientifically literate students who understand and appreciate the efforts of astronomers investigating the origin and evolution of the stars, galaxies, and the universe. Through the current distribution network (the ERC), COTF has put *Astronomy Village* into the hands of thousands of teachers. It is imperative that COTF expand this community of users. The results of this survey show that most of our registered owners of *Astronomy Village* are frequent attendees at national conferences. We may infer that exposure at national conferences such as NSTA and NCTM would be a cost-effective way to expand our community of users. We should continue to identify highly trained teachers at these conferences and introduce them to *Astronomy Village* through one- to four-hour workshops. For existing registered owners, we can use the national conferences as a vehicle for providing leadership training and continued discussion about effective implementation of *Astronomy Village*. In the long-run, *Astronomy Village* will only have an impact when a significant proportion of teachers in the United States are using the software to effectively teach scientific inquiry in astronomy.

Conclusion

The NASA Classroom of the Future has developed a high-quality multimedia product that can lead to effective learning outcomes. In order for the product to have a significant impact, however, a sustained effort to update the product is imperative, and the COTF needs to recruit talented teachers who can serve as community leaders for the implementation of *Astronomy Village*. *Astronomy Village* has the potential, over time, to help teachers use technology to achieve reform.

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