A LIVELY ELECTRONIC COMPENDIUM OF RESEARCH, NEWS, RESOURCES, AND OPINION

Astronomy Education Review

Volume 2, Feb 2003 - Dec 2003
Issue 1

Beyond the One-Hour Outreach Talk: Introducing a Reading and Writing Program into a High School Science Class

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Posted: 07/25/03

The Astronomy Education Review, Issue 1, Volume 2:138-143, 2003

Abstract

We present a discussion of a newly implemented one-year program that brings high-level science reading and writing into a remedial high school science class. In the program, articles from publications such as *Scientific American* and *Astronomy* magazines are used to teach current science topics and to reinforce reading and writing skills. These skills are critical for general knowledge, literacy, and for passing state standardized tests. Members of the astronomy community act as "writing coaches" to help guide the students through the reading and writing process. This program illustrates one way that astronomers can become involved with underserved populations.

1. INTRODUCTION

Data from the United States Department of Education show that K-12 students from either low income or minority backgrounds do not perform as well as affluent white students on standardized tests measuring reading skills (USDOE 2000). This difference in test scores is known as the "education gap." Teacher quality, socioeconomic factors, and school resource allocation have been put forward as the cause of this gap (Rothstein & Carnoy 1997; Haycock 1998; Ancess 2000; Brennan 2002).

Another suggested cause of the education gap is that poor and minority students tend to be tracked into remedial classes more often than affluent whites (Oakes 1986; USDOE 1998). Spade, Columbia, & Vanfossen (1997) show that schools that serve working class communities tend to offer fewer college preparatory science and math classes. In addition, the working class schools studied in this work did not do as good a job in counseling their students into high-level math and science classes as the schools serving affluent communities. Similarly, the introduction of high-stakes testing in many states, which requires students to pass a state standardized test in order to graduate, has created pressure on teachers to focus only on teaching basic skills to disadvantaged students. The higher-level intellectual development of these students is often sacrificed in an attempt to cram for these tests (Darling-Hammond & Wise 1985).

Recent research has shown that remediation simply does not work. Kerckhoff (1986), Gamoran et al. (1995), and Gamoran (1997) all have shown that students in remedial classes did not improve significantly in their standardized test scores, while students who took the most advanced schedules showed the highest increase in test scores. Test scores have increased across the board in schools where remediation was eliminated (Gamoran 1997). Research by the U.S. Department of Education (1999) shows that students in the lowest quartile of performers on national tests achieve higher gains when placed in a college preparatory—as opposed to a vocational—curriculum. In addition, research shows that most remedial high school literacy programs that focus on basic skills like phonics do little to help students (Larson 2000). Data from the National Assessment of Educational Progress show that the vast majority of high school students already possess these skills (USDOE 2001). Students' problems lie predominantly in adapting their basic skills to higher-level texts that use many unfamiliar and technical terms (Stanovich 2000).

"A Nation at Risk" (NCEE 1983) brought about the current discussion of science education reform, calling for more rigor in all science classes. Increasing rigor in schools that serve poor and minority students can be difficult. Obstacles include teachers unfamiliar with rigorous science, the presupposed inability of this population of students to engage in rigorous scientific instruction, and other systemic institutional factors within the school (Haycock 1998; Elmore 2002).

Bringing astronomers into a classroom is an obvious way to increase the level of scientific discussion in a class. Unfortunately, because of the obstacles listed above, many teachers and administrators may be unwilling to devote time to having a traditional astronomy outreach lecture (e.g., a PowerPoint talk combined with a hands-on activity) when there is so little time available to teach material required for state tests. How can astronomers get a foot in the door to both inspire students with advanced scientific concepts and provide the basic skills necessary for high school graduation?

2. SCHOOL AND CLASSROOM SITUATION

East Side High School is located in Gainesville, Florida and serves grades 9-12 with a student population of 1,652. The classes where this work was conducted average over 25 students each and serve primarily tenth graders. The majority of students were African American (80-90%). A sizable fraction of the students were enrolled in the special education program. The course covers basic biology, health topics, and physical science.

Students at East Side High School must pass the Florida Comprehensive Academic Test (FCAT) in order to graduate. The FCAT tests mathematics, reading, writing, and science. The FCAT is administered in tenth grade, so it is of particular importance to students in the classes studied here.

3. THE READING AND WRITING PROGRAM

The reading and writing program described here is fairly simple in concept, yet requires significant involvement with students to be effective. Articles describing current scientific progress were taken from sources such as *Scientific American*, *Astronomy*, and *Nature* magazines. The teacher and writing coaches, in collaboration, decided to use asteroids as the theme for the reading assignments. For example, the first article dealt with protecting the Earth from potential meteorite impacts (Nadis 2002). Incorporation of a theme, although not necessary, was a useful tool in prompting students to revisit arguments from previous assignments.

Students read the article and then completed a guided reading assignment, usually consisting of comprehension questions. Together, the teacher and writing coaches created these questions, which focused on the portions of the text that were to be important in the subsequent writing assignment.

For each article the students read, they completed a writing assignment. In the article mentioned above, the writing assignment was to compose a summary essay of the article. For other articles, students wrote persuasive, comparative, and review essays. These assignments were developed, again, through the collaboration of teacher and writing coaches. After completing their essays, each student reviewed his or her work with a writing coach.

This reading and writing program was designed for students with poor initial writing skills. The students were not familiar with how to compose, organize, and present written work effectively. The process used to guide the students' writing was similar to the way in which an advisor may guide new graduate students in writing their first grant or observing proposals. The writing coaches did not simply point out areas that needed improvement; instead, they provided specific instruction, concrete examples, and practical suggestions about how the students could better express their ideas.

The revision process was repeated until both the writing coach and the student were satisfied with the essay, and it was then submitted to the teacher for grading. The writing coaches stressed that writing is a process that requires multiple drafts and revisions. However, the writing coaches did not usually ask the students to rewrite their essays more than three times to prevent discouragement and loss of a sense of purpose for the particular assignment.

The papers were graded on a 1 to 4 scale, with 3 being a pass and 4 being excellent. A 1 or 2 triggered a rewrite. Student portfolios were kept by the teacher so that the students and writing coaches could review their progress.

This program was based on several key principles described below.

Reading and writing are two sides of the same process. Reading provides content knowledge and raw material for the students' written work. Writing provides time for reinforcement and reflection on what the students have learned through their reading. When a student is found to have either left out or included incorrect information in his or her writing, the teacher or writing coach can direct the student back into the text for further discussion.

Instant and detailed assessments are vital to the learning process. As a result of students having to make multiple revisions of their work, the teacher and coaches easily can determine the learning gains of students. Where students have included misconceptions or overlooked details in their writing, they can be put back on the right track immediately without the consequence of a failing or low grade on the assignment.

Failure is not an option. The primary goal of the program is to involve students in the excitement of current science and teach reading comprehension and writing skills. In this framework, it is not acceptable to permit a student to submit low-quality work for a grade. The many revisions and one-on-one work with the writing coaches should provide ample time for students to turn their original ideas into passable work. Over time and with involved mentorship, students who initially relied heavily on writing coaches should begin producing work more independently. The use of portfolios makes it possible to assess this growth.

4. WRITING COACHES

Writing coaches and writing rooms are an emerging phenomenon in many school districts. The most developed of these programs are in the Montclair, New Jersey and Berkeley, California school districts (Cole, Crowell, & Drake 2002). These school districts have used their writing centers primarily with English and literature classes. Both school districts report increases in student achievement since the introduction of their writing centers (Cole, Crowell, & Drake 2002). Our work is one of the initial attempts to bring this type of system into a science classroom.

In this case, we utilized three volunteer writing coaches who were professionals (astronomy graduate students from the University of Florida) in the field being taught. This allowed the coaches to be useful as resources for both content and good writing practice. There was no formal training program for the writing coaches. The volunteers participated because they were confident in their own scientific and other writing skills and had a desire to work with students. In this case, the teacher and writing coaches worked closely to design the assignments. This may not be necessary, as writing coaches easily could work in response to teacher-generated assignments. Other programs do require some training for their writing coaches, usually consisting of a few class sessions on writing instruction (Cole, Crowell, & Drake 2002). However, these other programs do not use volunteers from a specific content background as their writing coaches.

5. CONCLUSIONS; IMPLICATIONS FOR OTHER OUTREACH PROGRAMS

We have presented a description of a reading and writing program in a remedial high school science class that attempts to teach both astronomy content knowledge and reading and writing skills. This effort is an example of a long-term and high-level involvement between professional astronomers and K-12 classes. This program has existed for only one academic year, so it is impossible to judge its effect on student achievement measures, such as the FCAT pass rate. However, due to anecdotal evidence, we are willing to call the program a moderate success. Through interest sparked by the assignments, one student conducted an observing project with an astronomer at the University of Florida's Rosemary Hill Observatory and presented the data at the county science fair. Several other students have expressed a desire to move out of remedial classes so that they may explore a possible career in science. In general, there seems to be a level of excitement about these activities that is higher than with regular classroom assignments.

It is our belief that this type of extended involvement is necessary for all students, but even more so for the students who are often offered the least by their school systems. These students should not be ignored by the astronomy community. However, the standard one-day outreach talk consisting of a PowerPoint presentation and possibly some hands-on activities may not be particularly useful in circumstances similar to the ones presented in this paper. Astronomers can and should find new and innovative avenues into classrooms that serve disadvantaged populations, and align their approach with the needs of students. We present one way in which this is possible.

Acknowledgments

DLR acknowledges the guidance and support of Carlton Jordan and others on the staff of the Education Trust in the development of this program. We acknowledge the assistance of the anonymous referee in developing the Writing Coaches section.

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