

Making Earth and Space Science and Exploration Accessible

C.J. Runyon, K.A. Guimond, D. Hurd, G. Heinrich

Introduction

There are currently 28 million hard of hearing and deaf Americans, approximately 10 to 11 million blind and visually impaired people in North America, and more than 50 million Americans with disabilities, approximately half of whom are students. The majority of students with disabilities in the US are required to achieve the same academic levels as their non-impaired peers. Unfortunately, there are few specialized materials to help these exceptional students in the formal and informal settings. To assist educators in meeting their goals and engage the students, we have been working with NASA product developers, scientists and education and outreach personnel in concert with teachers from exceptional classrooms to identify the types of materials they need and which mediums work best for the different student capabilities. Our goal is to make the wonders of earth and space science and exploration accessible to all. We present a list of suggested best practices and example activities that can help engage and encourage a person with special needs to study the sciences, technology, engineering, and mathematics.

Method

Over the last four years we have been hosting interactive workshops, observing classroom settings, talking and working with professional educators, product developers, museum and science center directors and parents to synthesize the most effective media and method for presenting earth and space science materials to audiences with exceptional needs.

Observations and Generalizations

Evident from the both the formal and informal settings is the need for educational materials and resources designed specifically for special education students. When asked about the process of selecting texts and other materials for the students in their classes, special educators often responded that they were given the same texts that general education classes were using, though on a lower grade level. The texts and materials are generally not appropriate for their students for several reasons: students in special education generally require more extensive practice with new material than their non-disabled peers; texts written for normally achieving students move quickly from one concept to another, often without ample explanation of how a concept just learned is related to what is to come next. This simple, yet easily overlooked, practice is an essential key to the success of students with diverse learning needs.

The educational needs of students in special education classes and informal settings are as numerous as their patron students. Well designed museum and science center displays can be very effect learning tools for the exceptional needs audiences. By permitting 'dwell-time' at an exhibit a student can synthesize the visual display material with available written and/or auditory descriptors. Often however, the displays are not inviting as they are intangible behind plexi-glass or ropes, the descriptor text is small or printed with poor contrast making it difficult to read, and there is often a great deal of noise in busy museums. Educators are challenged to discover the strengths of each of their students and to assist their students in using these strengths to work through, and overcome, personal weaknesses. Fortunately, there are several generally accepted techniques (outlined below as "best practices") that have been shown to be effective in helping most students with disabilities achieve greater success in the formal and informal learning environments.

Best Practices for Working with Audiences with Special Needs

- New lessons should **begin with a review of concepts**. Educators should not assume that students recall even the most pervasive concepts. Audiences' prior knowledge needs to be tapped and explicitly linked to new information.
- **Use simple, sans-serif fonts and high contrast presentation media** such as black text on white background (white on black is best for senior citizens). Avoid the use of similar color tones such as light blue and dark blue next to each other. Avoid light blue all together. Educational materials must be varied to be effective.
- Student strengths are diverse; therefore, materials that **present information in a variety of ways** will be most effective (e.g., tactile, visual, auditory, smell; repetition; hands-on)
- Distractibility is a common problem among students with mild disabilities. To counter this tendency to "check out" of a lesson, **audiences should be actively involved** in activities by making frequent responses or movements.
- **Frequent questioning** of students as material is being covered allows educators to not only keep students involved in the lesson but also provides the opportunity to assess individuals' understanding and make necessary adjustments to the lesson.
- Lessons and activities should be **easily adaptable** dependent upon students' response. Continuing with a particular method that is confusing to students serves only to increase student frustration and resistance to further participation.
- Some of these students may show confusion when presented with figurative examples or images, such as cartoons or symbolic representations. It is generally best to **provide examples and images that are realistic** and therefore easier for students to identify with. Earth and space sciences are full of them!
- Students with special needs generally require more **precise and frequent feedback** regarding their progress than do their non-disabled peers. This feedback not only serves to reinforce students' effort but also reduces the likelihood that students will practice skills incorrectly.
- **Repetition and practice** with new material or concepts is essential for persons with special learning needs. These students should become proficient at a task or have a complete understanding of a concept before moving on to another skill or subject area.
- **Direct, explicit instruction** should be accompanied by a related activity that allows students to work with abstract concepts and make understanding more concrete.
- Many students with special needs thrive in an **environment that is structured** and provides a **consistent routine**. Such an arrangement offers students more control over their educational situation since they can more accurately anticipate what is to come.

Integrating Earth and Space Science into the Special Needs Curriculum

Following the principles and techniques outlined above are essential for successful learning by students with special needs. Science education is not among the top academic priorities in most special education classrooms. This lack of focus on science is not the result of a lack of interest on the part of the students or teachers. On the contrary, both teachers and students are incredibly excited and inquisitive regarding earth and space science lessons. The challenge lies in integrating the science with the language and math in order that they can fully understand the science concepts. To effectively impart a basic understanding of science to these students in the hopes of igniting their curiosity to learn, these realities need to be kept in mind. Curriculum that employs the "best practices" described earlier while integrating the basic skills of language arts and mathematics along with scientific investigation and reasoning appears to be most effective in reaching this population of students. In addition, special education teachers, who are generally more familiar with teaching basic skills than scientific practices need appropriate training and resources to make such changes long-lasting. By more fully understanding the realities of special education in today's formal and informal education settings, those who seek to contribute to the education of this population of students can do so with greater confidence that their efforts, and those they seek to educate, will meet with success.