

Special Students: Exploring the Best Methods for Learning  
Science

May 2, 2003

By

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In partial fulfillment of the requirements in SCE 5308

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**Abstract**

This study explored how special needs students in a lower grade level elementary science class learns science best. The data was collected through conducting observations and administering a pretest and posttest for learning about plants by means of hands-on experiences, sampling 82 students and through a posttest for the textbook approach for the life cycle of frogs sampling 91 students. Using a sample group of the above referenced students and a t-test for independent samples, it was found that students who had a hands-on learning experience gained more knowledge of the topic than did the same students with a textbook or pen and paper approach. It was concluded that a hands-on approach to learning science was better suited for special needs children than other methods tested.

## **Introduction**

"Science is for all students," according to the National Science Education Standards (Haskell, 2000, 1). This statement is the educational thought for the United States. Science classes provide special needs students with opportunities they may not get anywhere else (McCann, 2002). Every student in a regular education classroom regardless of race, beliefs, abilities, or disabilities deserves an education just as their fellow classmates. Students learn science through various ways from hands-on activities, to textbook, lecture, and inquiry learning. Approximately ten to twelve percent of the school age populations in the United States have disabilities that require special education services (Haskell, 2000). This study will examine several different approaches to teaching science and discuss the best way for special needs children to learn science in a regular education classroom.

## **Review of Literature**

Many studies have been conducted to show educators the best means for teaching science to special needs students. Some writers say that hands-on science extending it to inquiry and direct instruction is the best way. Others say that the age-old method of textbook, pen, and paper is the most beneficial. Many educators simply are uncomfortable teaching in a hands-on environment. These particular teachers find that worksheets and

textbook based activities provide the structure that they are comfortable with. There are various significant risks connected with the textbook approach. First, as pointed out by Wong, teachers many become complacent and start confusing survival with teaching (Huber, 2001). Rather than making the transition into mastery teaching, these teachers begin believing that the maintenance of a smooth classroom environment evidences effective teaching (Huber, 2001). Second, the worksheets promote erroneous and impoverished concepts regarding the nature of science (Huber, 2001). The hands-on activities tend to be dominated by the mechanical tasks characteristic of the work of laboratory technicians rather than the creative endeavors of scientists (Huber, 2001). Finally, the students are not allowed to take ownership over their own studies. Rather than designing and carrying out investigations to answer their own questions, they are following instructions to find out if they guessed the correct answer to the teacher's questions (Huber, 2001). Based upon the reviews of literature, hands-on activities is the most beneficial way for a student to explore and master new concepts.

### **Guidelines for Learning**

Particular guidelines should be considered when teaching science to special needs children. By following these, teachers can provide students with an optimal learning experience. Tasks should be uncomplicated, brief, and sequentially ordered and

presented. Success should be built into each task. Furthermore, over learning must be built into the lessons. Over learning is the repetition of concepts so that retention may occur. Lastly, learning tasks should have application to the learner's life (Retish & Wielert, 1983).

### **Methods of Teaching**

Techniques for teaching science have been a debated issue for decades. Some educators think that a textbook approach prepares the students for higher-level education such as college in reading and standardized achievement tests like the TASP. While other educators believe the hands-on approach leads to a better understanding of the subject matter because of the learning by doing method. Everyone learns in a different way: some are kinesthetic, visual, or auditory. Educators need to design a lesson around their students' needs and how they learn best. Direct instruction is teacher focused were as discovery teaching or indirect teaching is child-centered.

### **Direct Instruction: Textbook**

This method of teaching science is considered to be the least desirable to most educators and students. In the mid 1970's the textbook method was being used because of the "back to basics" movement, which was inspired by declining test scores and increasing political conservatism (Bakken, Brigham, Mastropieri, & Scruggs, 1993). A textbook contains enormous

amounts of vocabulary. Special needs children need to learn new vocabulary, but not in the manner it is presented in a textbook for several reasons. The words can be hard to read and comprehend; the readings maybe above their individual reading levels. This particular approach also tends to use pencil and paper work heavily. Students are asked to complete the pre and post chapter questions. In addition, textbooks have worksheets that go along with the chapter that maybe difficult. Many students with learning disabilities perform poorly on reading, writing, and or language tasks (Haskell, 2000). Using only paper and pencil assessment tools measures the level of the student's language arts abilities, not the level of understanding for the science concept or for the skill in question (Haskell, 2000). Students have difficulty learning from reading and worksheet assignments (Bakken, Brigham, Mastropieri, & Scruggs, 1993).

### **Lecture**

This particular method may present problems for students who have short attention spans like Attention Deficit Disorder (ADD) and Attention Deficit Hyperactivity Disorder (ADHD). Lectures can be long and tedious. Sometimes the material presented maybe over the levels of each student within the classroom. If this method is over-used then it could lead to inappropriate behavior and students "tuning out" to what is being presented (Retish & Wielert, 1983). Lectures need to be

short and to the point for these special needs children. If repetition of concepts needs to occur it should be completed through other ways.

**Indirect Instruction: Mnemonic**

The mnemonic approach is known as the memory-enhancing strategy. It acts as a study guide. This method has resulted in spectacular increases in concepts learned and retention for learning disabled and educable mentally retarded students when compared with more traditional instructional approaches (Gaffney, Levin, Mastropieri, & Scruggs, 1985). This strategy cues the students to relevant information while allowing the development of note-taking skills and reading strategies (Haskell, 2000).

One method of mnemonics is known as the keyword method. It allows for factual information to be retrieved. This method uses the "three R's" of mnemonic techniques. The first "R" stands for the recording. This part is where an unfamiliar word is transformed into a concrete, familiar word that sounds like a salient part of the to-be-learned word (Gaffney, Levin, Mastropieri, & Scruggs, 1985). For example, viaduct could be transformed into the keyword duct. The next "R" stands for relating the keyword to a desired response via an interactive episode. Still using viaduct-meaning bridge as the example, an interactive episode of a duck could be pictured waddling across

a bridge (Gaffney, Levin, Mastropieri, & Scruggs, 1985). Finally, the last "R" is known as the retrieving aspect. This means that the student will get the meaning of the new word. In the example viaduct, the learner is led directly from the stimulus to the keyword to the interactive picture to the correct response (bridge) (Gaffney, Levin, Mastropieri, & Scruggs, 1985).

### **Activity/Inquiry Learning/Hands-on**

There has been a reform in science education in today's schools. Project 2061 has been implemented to emphasize the need for inquiry and hands-on learning for children. These areas are perfect for including students with particular requirements. Science classes provide students with the benefits of concrete, real-world experiences, opportunities to work effectively in-group situations, the excitement of scientific observation and experimentation, and alternative methods of evaluation (BC Education, 2003). These particular approaches engage students in using the multiple literacies of all disciplines while gathering data, determine how the data constitutes evidence for the claims the students are generating, sharing and evaluating the claims with fellow classmates. These activities provide positive leaning experience for all involved. Collaborative activities may also provide the aid for handicapped students that will aid in their social integration (Retish & Wielert, 1983). "Science

education should prepare individuals to utilize science for improving their own lives and for coping with an increasingly technological world" (Retish & Wielert, 1983, p. 557).

Teachers are challenged in inquiry-based instruction. Educators need and have to derive at kinds of problems that will engage their students. This curriculum area is ideal for creative learning experiences and critical thinking activities for special needs children, and students with exceptional gifts and talents (BC Education, 2003). Educators have to assess their student's progress towards their student's goals.

Students using these methods learn through doing the experiments and may build on prior knowledge. Students tend to retain the information being learned from these hands-on approaches versus concepts learned via a textbook method of reading chapters and answering questions on paper. Less vocabulary is used with this method. The students can spend more time interacting with actual examples of the concepts being studied. Students tend to like these approaches better commenting that it helps them learn more and it is more enjoyable. Also, students say they consider these methods of using concrete materials more facilitative to their learning and it motivates them (BC Education, 2003). When the curriculum allows the teacher to facilitate process rather than disseminate

information, it can assist students with special needs to construct their own knowledge (BC Education, 2003).

FOSS (Full Option Science System) is an alternative for science curriculum. This system provides structural and sequential hands-on activities. Students are encouraged to investigate, gather data, organize the results, and draw conclusions based on their own actions and personal experiences (FOSS, 1996).

Another approach that educators have used and found successful is CWPT (Class wide Peer Tutoring). Studies have shown that students increased their test scores on standardized testing and by seventh grade fewer students required special education services (Haskell, 2000). Peer tutoring increase the students learning experiences and gives the students feedback immediately. This is a key component for special needs children to further their learning opportunities.

## **Methods**

A survey of ninety-one students was conducted using a pretest and posttest to measure concepts learned about plants through hands-on activities (see Illustration 1). Both tests administered were exactly the same. Then another group consisting of eighty-two students was used to measure the concepts learned about the life cycle of a frog via the textbook

approach (see Illustration 2). This group of students was given a posttest.

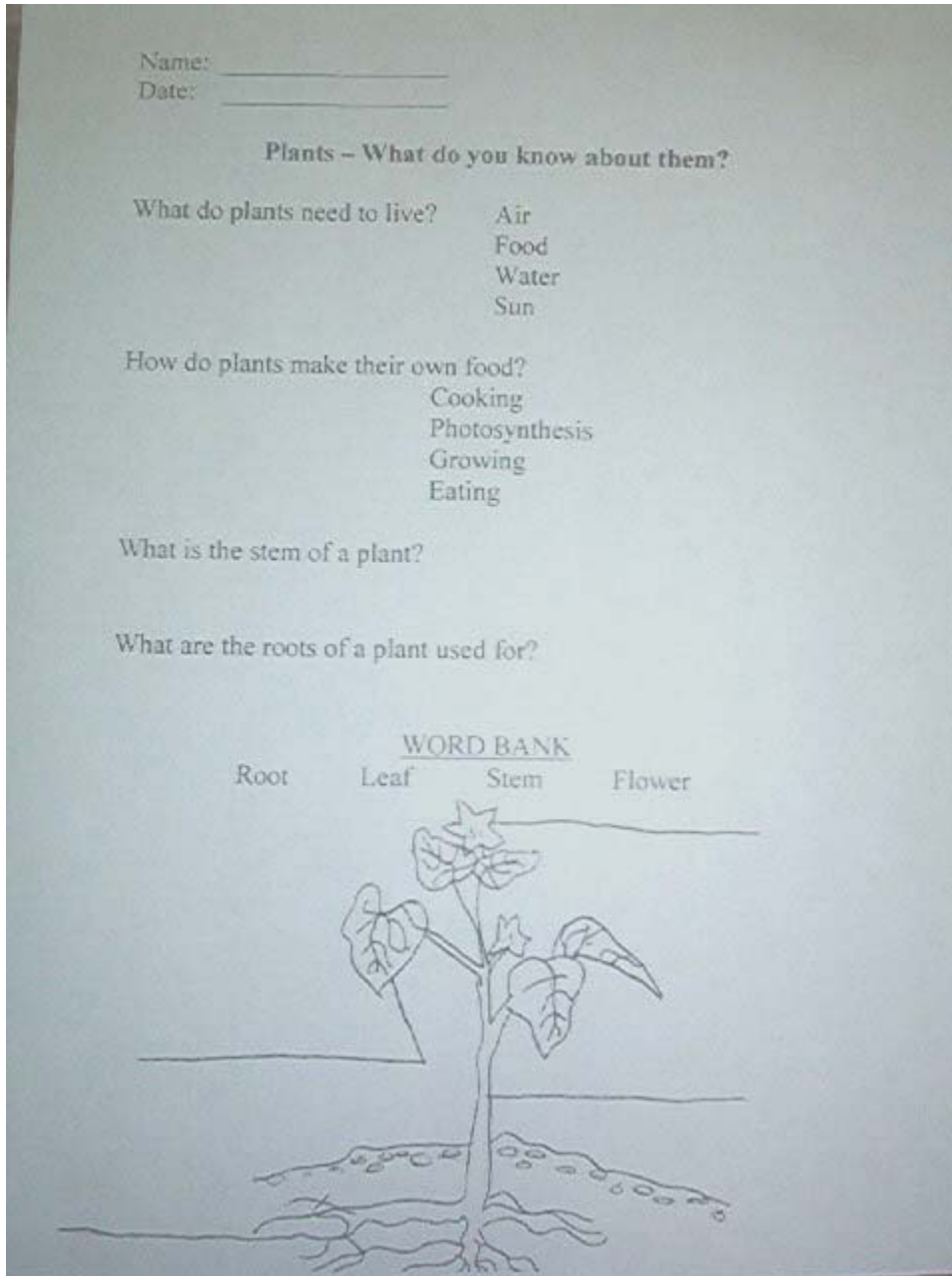


Illustration 1: Pre/post test on plants

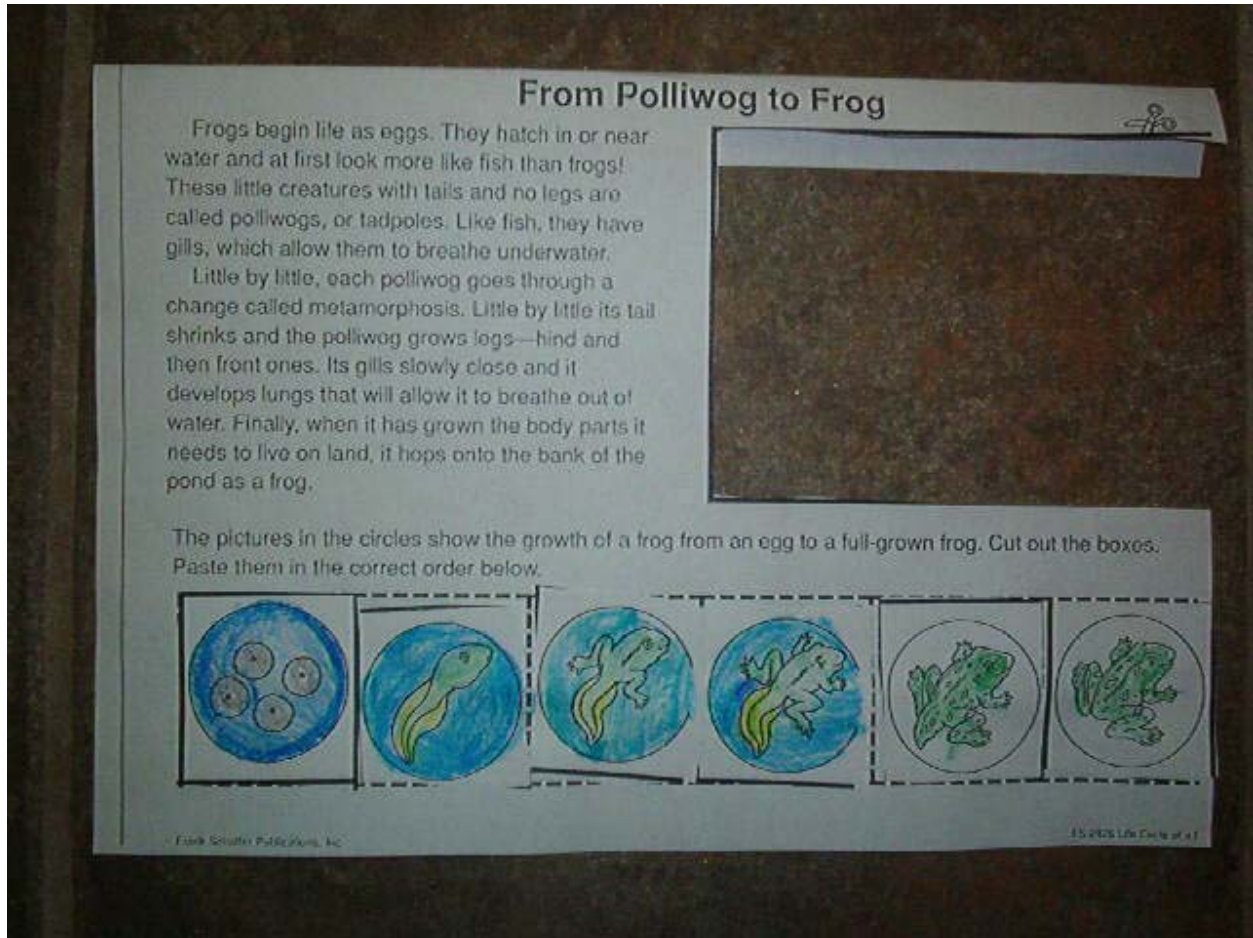


Illustration 2: Life Cycle of a Frog

## Results

Based upon the research conducted, it was found that hands-on and textbook approaches provided for most favorable learning experiences. These results were a bit surprising. It was stated in the beginning that a hands-on style of learning would produce the best means for special needs children to learn science concepts. Both approaches produced results with which an educator would be content.

| Questions: | Group Pretest |          | Total Students | Group Posttest |    | Total Students |
|------------|---------------|----------|----------------|----------------|----|----------------|
|            | Yes           | No       |                | Yes            | No |                |
| 1          | 31            | 51       | 82             | 22             | 9  | 31             |
| 2          | 34            | 48       | 82             | 22             | 9  | 31             |
| 3          | 5             | 77       | 82             | 8              | 23 | 31             |
| 4          | 1             | 81       | 82             | 6              | 25 | 31             |
| Labels:    |               |          |                |                |    |                |
| Flower     | 63            | 19       | 82             | 22             | 9  | 31             |
| Leaf       | 67            | 15       | 82             | 22             | 9  | 31             |
| Stem       | 61            | 21       | 82             | 23             | 8  | 31             |
| Roots      | 58            | 24       | 82             | 23             | 8  | 31             |
|            | 0.010414      | 0.002362 |                |                |    |                |
|            | 63.657        | 636.619  |                |                |    |                |

Illustration 3: Results of Pre/post Test on Plants

The results in Illustration 3 were given based on a pretest and posttest for a hands-on lesson about plants. Most of the eighty-two students on the pretest did well. Of the twenty-two students who took the posttest most also did well. Questions three and four on both tests were difficult for the students to answer. This was probably because there were no answer choices from which the students could choose. Having to come up with

answers to write was somewhat scary for the students. When asked these questions the students could explain the answers verbally.

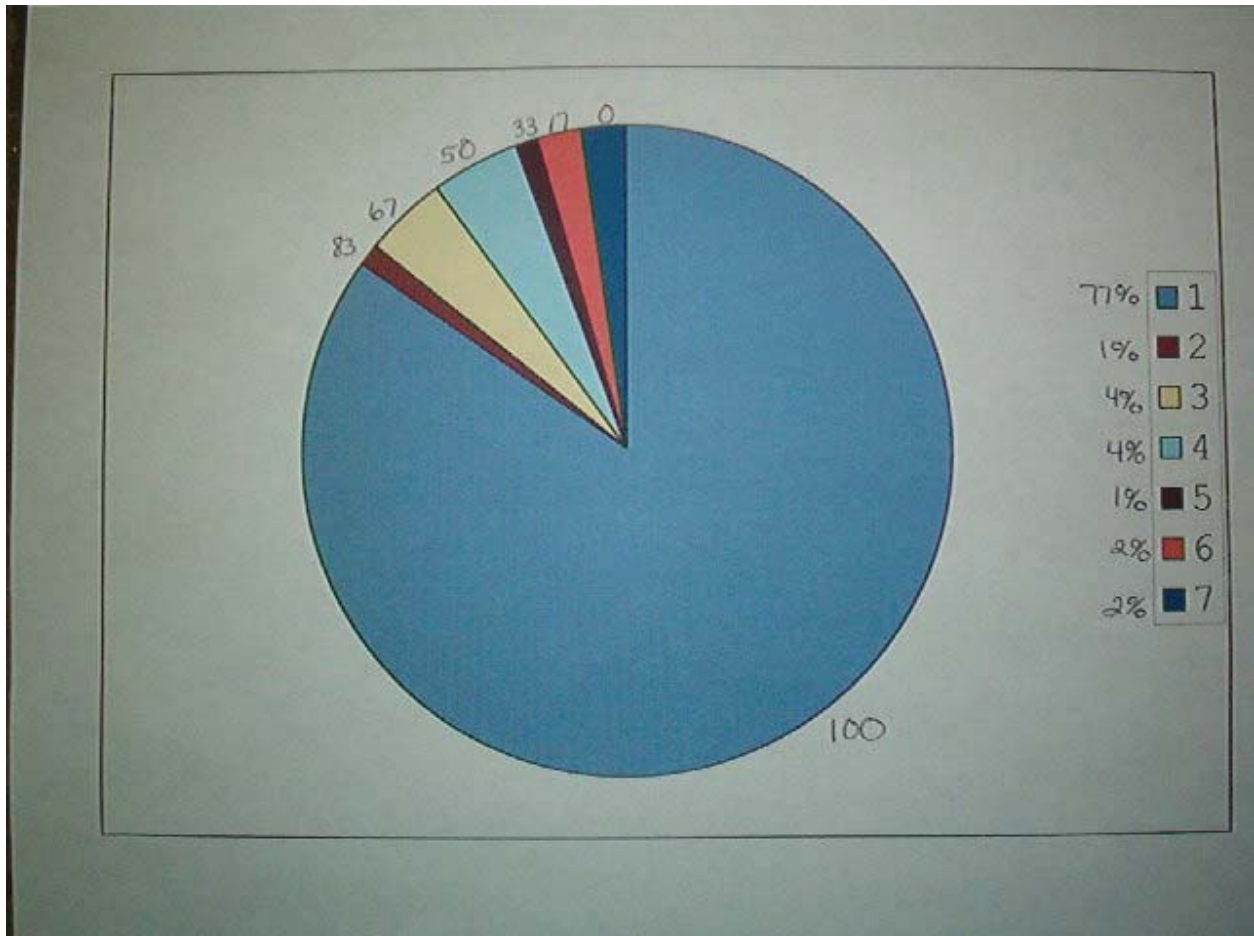


Illustration 4: Pie Chart of Test Results

The pie chart in Illustration 4 shows that out of ninety-two students who were given a posttest on the life cycle of a frog, seventy-seven percent made a perfect score. These results were amazing because the students were not given a pretest so that they were not exposed to the information beforehand as they had been on the plant lesson. In addition, the

students had to read the information on their own. This is a difficult task for some students either because they simply cannot read or because they were not familiar with some of the language used.

These results do not compare to the results given from the pretest and posttest on plants because different numbers of students were used. In addition, the students were not given a pretest for the life cycle of a frog. However, both of the results demonstrated that the students did learn the specific tasks at hand regardless of the manner in which the lessons were presented to them.

### **Conclusion**

Although data from this study are inconclusive due to the small sample size and limited instructional time, the inquiry based and hands-on activity approach is the best method for special needs children to learn science. "Inquiry includes student activities that develop conceptual understanding of scientific concepts as well as strict scientific inquiry," (Eick, 2000, p. 2). According to the study conducted by Charles Eick one of his intern studies stated, "I believe science should be taught in a hands-on, minds on matter, I consider inquiry strategies to be very important. If students are able to get hands-on experiences that lead to inquiry in science, I feel that they will be able to learn more than if they were learning

in the traditional manner" (Eick, 2000,6). In another study, a teacher who taught FOSS stated her students exhibited deficits in their short-term memory. However, through the use of a sequential hands-on approach such as FOSS, useful information got stored in the students' long-term memory. She credits the success and exceptional growth of her students in science to FOSS (FOSS, 1996). These approaches provide for optimal learning experiences, and the majority of educators still prefer to use inquiry, hands-on activities for students to learn from. After all, "learning science is an active process," (Haskell, 2000, P.4).

Researchers should use this information to inform educators of the valuable lessons that could be taught within the classroom in which students are involved in their own learning. The outcomes are positive and endless. Maybe the averages on standardized tests would greatly be impacted if teachers use hands-on science activities within their classrooms. In addition, students maybe more apt to follow a career in which science would be the basis.

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