Meeting the Needs of the Special Learner in Science

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One-hundred-and-twenty secondary science teachers responded to a survey entitled Teaching Science to Students with Special Needs in Inclusive Settings *to assess their knowledge and preparation in working with students with special needs in the science classroom. The authors focused on the following questions (1) How can a secondary science teacher with no training in the area of students with needs adjust his/her teaching strategies? (2) What resources can the secondary science teacher utilize to teach students with special needs? And (3) What does the secondary science teacher need to do, to better meet the needs of special learners? The authors discuss methodologies that can be used to assist science teachers in effectively teaching students with special needs. The researchers propose effective practices to help teachers to help students with special needs achieve and become interested in science. A qualitative and quantitative research design was used to analyze the data. Results of the survey revealed that, one hundred percent (120) of the teachers surveyed needed support on various instructional methodologies to be more effective in teaching science to special learners.*

According to various organizations and mandates such as Public Law (PL) 94-1427 (1975), special education and scientific investigation have become inextricably connected over recent years. PL 94-1427 is an act that states that all individuals with a handicap should be offered a *free appropriate public education which emphasizes special education and related services designed to meet their unique needs, to assure that the rights of handicapped children and their parents or guardians are protected, to assist states and localities to provide for the education of all handicapped children and to assess and assure the effectiveness of efforts to educate handicapped children.* (http://asclepius.com/angel/special.html, 2006).

Although the growing importance of science education for students with disabilities has been recognized, research by Patton, Polloway, and Cronin (1990) indicated that many students with disabilities receive very little or no science instruction. Because many special and general educators have not been adequately prepared to teach science to students with disabilities (Gurganus et al., 1995), they often either use a content-oriented approach that focuses on learning vocabulary or factual text-based information through textbooks and teacher-directed presentations such as lectures and demonstrations (Mastropieri & Scruggs, 1994; Weiss, 1993). This approach requires students to have certain levels of reading, writing, and memory skills; thus, many students with disabilities do not benefit from this approach (Mastropieri & Scruggs, 1993). They therefore often receive low grades and perform significantly below their general education peers (Holahan, McFarland, & Piccillo, 1994; Parmer and Cawley, 1993). Students with disabilities, however, can learn and master content in the general education curriculum when teachers employ instructional adaptations based on certain kinds of effective practices (Grossen & Carnine, 1996; Scruggs & Mastropieri, 1993). Successful science teaching approaches include tutoring, cooperative learning, mnemonic strategies, and self monitoring strategies (Mastropieri and Scruggs, 1995).

Many of the students who have not become part of the current science education reform movement are poor, students of color, or students with disabilities. Others are English speakers of other languages (ESOL) (Minicucci et al., 1995) and yet others may demonstrate social-personal, and intellectual disabilities. Students with disabilities are often homogenously grouped in self-contained classrooms where they have little interaction with other students in the school and are excluded from science education reform.

Students should have the most competent teachers with an in-depth understanding of the subject matter to ensure that grade level standards are met. These requirements apply whether the teacher provides core academic instruction in a regular classroom, a resource room or another setting. General education and special education teachers need to be knowledgeable and skilled in how to teach all students, including students with special needs, so that all students can achieve to high academic standards.

The *No Child Left Behind* (N.C.L.B.) Act strongly affirms that all students including those with disabilities can achieve high standards. N.C.L.B. works in conjunction with the Individual's with Disabilities Education Act of 1997 (IDEA), which is the nation's special education law. Under this law, students with disabilities must have access to the same good high-quality curriculum and instruction as all students.

Schumm, Vaughn, Gordon, and Rothlein (1994) suggest that teachers are not likely to change their teaching behavior unless they are given the skills, knowledge, and confidence to do so. When new contents or new skills are presented over a series of training sessions that include a limited amount of information, followed by opportunities for classroom practices with coaching, changes in teaching become evident (Guskey, 1986; Joyce & Showers, 1983; Joyce & Showers, 1988; Sparks, 1983).

Special education is more demanding than mainstream education as confirmed in the literature. Wolfendale (1992) emphasizes that the skills and expertise needed for special needs teaching are clearly different from the teaching skills required for mainstream learners. Bos and Vaughn (1994) therefore contend that teachers need special training for students with special needs.

Problem

Many teachers who teach science lack the training and resources to adequately teach students with special needs. Since the majority of students with special needs receive their science education in general education classrooms, it is incumbent upon the special educator to implement and validate curriculum and instructional support systems which aid the students in becoming competent and knowledgeable of the processes, concepts, and principles of science. Participants from the *Developing Teacher Leaders in Middle and High School Science,* who responded to the *Teaching Science to Students with Special Needs in Inclusive Settings* recognized that students with special needs must meet the same high standards as all students in the classroom. They believe that *watering down of the curriculum* is a disservice to all. With the push for placing special needs students in inclusive classrooms, science teachers must be provided with continuous training to effectively teach students with diverse learning styles.

Purpose

This article will focus on the working with students with special needs in the secondary science classroom**.** The overall goal of the *Developing Teacher Leaders in Middle and High School Science (DTL's)* Project was to help science teachers increase their content knowledge and upgrade pedagogical skills in secondary science.

The DTL project included three approaches: 1) interactive lectures and laboratories, 2) alternative teaching and assessment strategies, and 3) teaching activities which were consistent with national and local standards. Workshops were held on a variety of topics designed to support the pedagogical growth of participants. For instance, the session on *students with special needs* addressed ways and methods for working with special-needs children in the regular classroom.

Research Design:

The research design is both quantitative and qualitative. A pre-and-post test was administered to the secondary science teacher participants to assess their experience in teaching students with special needs.

Method

One hundred and twenty one secondary school (middle and high) science teachers from the Washington, DC metropolitan area who also participated in the professional development project funded by the National Science Foundation. Surveys were administered to participants at the beginning of pedagogical sessions to assess their prior knowledge of and/or familiarity with specific topics. For example, participants were given a pre-assessment survey to determine the extent of their prior knowledge of working with special needs students.

Each teacher received approximately 50 hours of professional development training with six hours geared toward working with diverse learners. During the professional development sessions, teachers received direct, hands-on instruction and retraining in the fields of special education. The sessions were conducted by university professors from their area (special education, reading biology etc.) of expertise. The sessions *meeting the need of the special learner* focused on pedagogical skills. Many of

the concepts examined during the sessions included specific topics of interest identified were indicated by participants who completed a pre-assessment survey. Teachers who participated in the session had the opportunity to:

1. Gain new information on current issues in the area of teaching students with special needs
2. Experience hands-on activities related to fostering students interest in the content area
3. Share ideas and activities with other teachers, and
4. Adapt new information to their curriculum so that it could be used in their specific classroom environment**.**

Teachers were assisted to design activities especially for special need learners. *Science Activities for the Visually Impaired* and *Science Enrichment for Learning with Physical Handicaps*, both developed at Lawrence Hall of Science at the Berkeley campus of the University of California (http://www.His.Berkely.edu) were introduced to them.

The project enhanced instructional practices that were grounded in the constructivist approach. The focus was on hands-on activities and pedagogical approaches in increasing skills in various content areas. Teachers were encouraged to adopt alternative methods of instruction and to rely less on traditional methods, such as requiring students to work individually and participate in classroom discussions led by the teacher followed by rote question and answer sessions. Participants were thereby encouraged to integrate the *5E's (Bybee, 2005) approach (Appendix A)* (engage, explore, elaborate, explain, and evaluate) into their daily teaching by modeling the theory of constructivism in the classroom and through shared lesson planning. The 5 E's model utilizes an inquiry-based approach that provides students with concrete learning experiences and a starting point from which to construct science concepts. In this model, learning is viewed as an active rather than a passive process. Teachers were encouraged to become facilitators of learning in order to help students acquire knowledge that is meaningful to their lives.

After the professional development intervention, participants responded to a survey entitled *Teaching Science to Students with Special Needs in Inclusive Settings* (Appendix B) to assess their knowledge and preparation for working with special learners. Assessments were performed by the project staff and external evaluators through observations of participants in various individual and group learning activities to test their delivery of content, and comprehension.

After participating in the long term (50 contact hours) professional development teachers were observed in their classrooms. Seventy-six (76) classroom observations data revealed that a majority of the teachers demonstrated varying degrees of the constructivist approach in their teaching practices. Particularly, most teachers presented a lesson using the 5E's method. Teachers initially began each class period by engaging students in warm-up activities that ranged from mini-lab experiments, to defining vocabulary words, to watching a video about basketball to learning the concepts of bar and line graphs which included all students with different learning abilities.

Technology was integrated into many lessons, with the teacher using overhead projectors, requiring students to use the internet to research assigned topics or to complete in-class assignments. One classroom teacher supplied calculators to each group of students to complete an in-class assignment. Individual seatwork was rarely observed in the classrooms. Collaborative group work and team work were the preferred methods employed by the teachers, especially at the middle and junior high school level. When working with mixed-ability groups with students with special needs, students were often assigned a role, such as recorder, researcher, and equipment operator. In a sixth-grade classroom, the lesson for the day was to design a scale model of the solar system using paper towels, magic markers, tape, a data sheet for scale calculations, and a ruler. The teacher began the lesson by asking students to recall what they knew about the solar system. Students eagerly raised their hands to share their prior knowledge. Students were then divided into groups of 5 and each group completed the same assignment. The students were permitted to work in the hallway outside of the classroom, and each student in the group was assigned a role. The students were actively engaged in the learning process throughout the entire observation period, and they worked collaboratively for 90% of the observed time.

In one ninth-grade science class that comprised students receiving special education services and those receiving regular education services, the teacher wrote the objectives of the lesson on the blackboard, as well as the warm-up activity, and the assignment due for the week. The teacher began the lesson on water pollution by allowing each student to select a small labeled canister. As the teacher read *The*

Pollution Story, each student walked to the front of the classroom when his or her material was called and dumped the contents of the canister into the fish bowl. The fish bowl was filled with fresh, clean, water prior to the beginning of the lesson. As more and more elements were added to the water the students saw first-hand how the water became polluted from various materials and elements. The students were actively engaged in the activity. Following the story, the teacher presented five questions on the overhead projector, which students were instructed to answer in their journals. The questions were related to the pollution activity, and included questions such as: a) who polluted the river, b) what could have been done to stop it, c) how can they clean the river of pollutants, d) is it easier to clean the river or to prevent pollution, and e) what could you start doing today/right away to help improve the water shed where you live? All students were actively involved in the activity.

Results

The results of the survey (see Appendix B) developed and administered by the Howard University project staff indicated that a majority of participants improved their content knowledge after participating in the advanced training. Sixty per cent of the participants taught in a Junior High/Middle School and 40% taught at the high school level (See Figure 1) of which 65.8% were female teachers and 34.2% were male (See Figure 2). The participants represented diverse ethnic groups (See Figure 3). A significant number (26.6%) of the participants had 20 or more years of teaching experience (See Figure 4); 45.1% had obtained a Bachelor's level education and 33.1% of the participants had a master's degree (See Figure 5). Approximately 95 per cent of the teachers were certified including provisional and temporary certification (See Figure 6).

Figure 1
Participating Schools

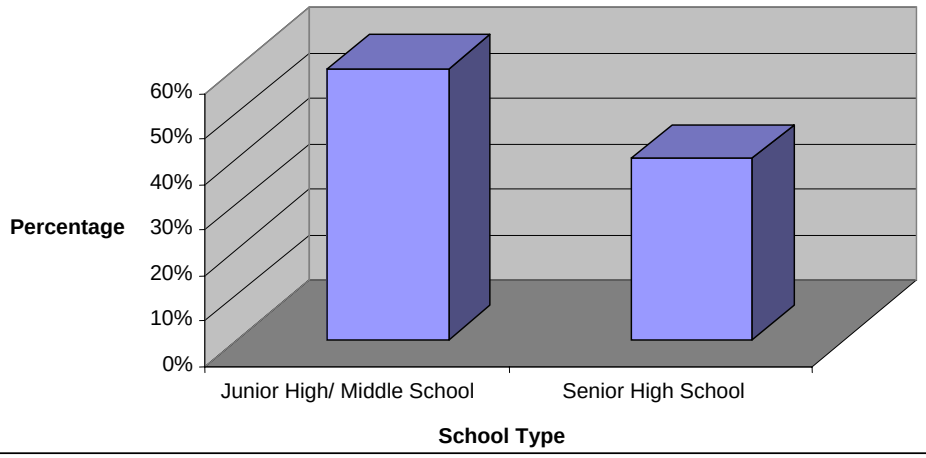


Figure 2
Gender of Respondents

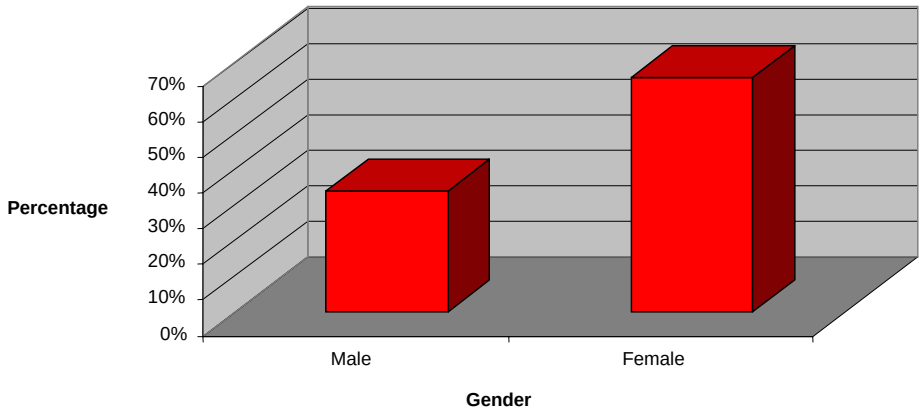


Figure 3
Ethnicity of Respondents

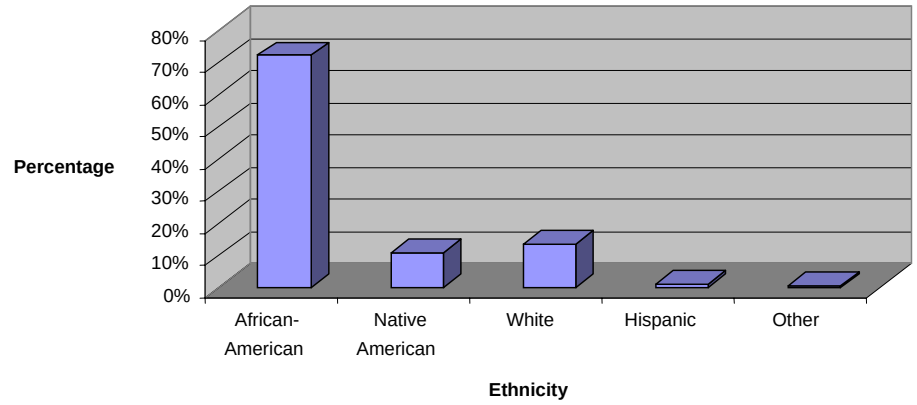


Figure 4
Respondents Years of Experience

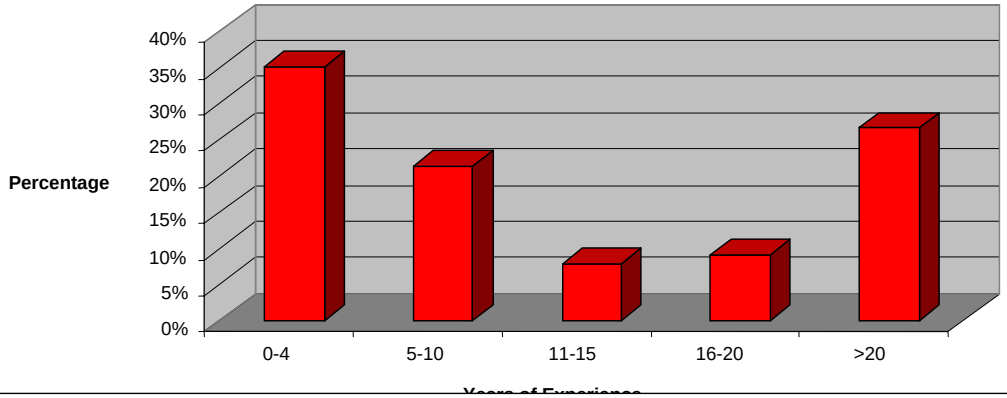
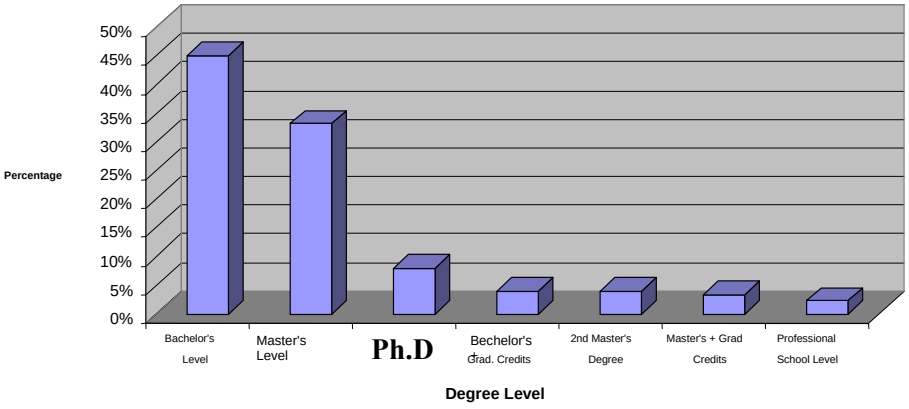
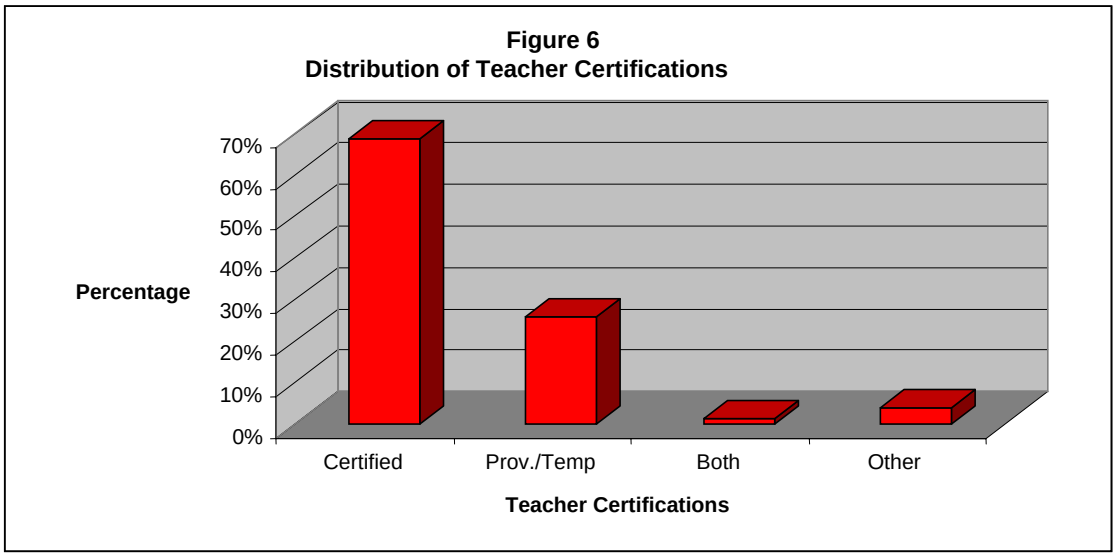


Figure 5
Degrees Held by Respondents





Responses from the following questions were analyzed:

In which specialty area were you trained as a teacher?
One hundred per cent of the teachers revealed that they had not been trained in special education.

Have special/inclusive students been identified in your class (es)?
One hundred per cent of the teachers indicated that they students with special needs were placed in their regular science classes.

If you teach included students, what do you need as support in order to a better job of teaching?
The ninety two per cent of the teachers expressed the need for more professional development to increase the skills needed to teach students with special needs. They also indicated the need for special training to teach students with special needs. The teachers also indicated that they had various groups of students by ability in the mainstream classroom, and requested suggestions and ideas for appropriate teaching styles for special needs inclusive students. They stated that short attention span or lack of understanding of special needs students contributed to behavioral challenges. The teachers stressed that two or more students with special needs who are placed in their classroom require them to have additional responsibilities and more work. Teachers ascertained that they had to plan and adapt activities and materials to ensure the participation of some learners with special needs. They expressed that they needed modification materials, and would appreciate resources such as classroom aides or assistants to assist them in the implementation of lesson plans and classroom activities/curriculum.

Have you had any staff development, relative to included students?
Of the 120 teachers who participated in the project, 18 reportedly received staff development training related to students with special needs. Some of the teachers had no prior background experience teaching science to students with special needs.

Would you like to have more information regarding included students?
All 120 teachers responded *yes* that they would like to have additional information on teaching strategies, effective resources, and materials that can be used to successfully teach students with special needs. Resources and materials used by the teachers of special learners can have a great impact on what and how information and skills are taught.

Discussion
Teachers were encouraged to familiarize themselves with what are the special needs of the learner, adapt and modify materials and procedures to meet the needs of the special learner. In regards to content, teachers were encouraged to incorporate activities into lesson that engage all learning modalities-visual, auditory, tactile, and kinesthetic. Observations of an English Language Learner (ELL) science classroom revealed that the 5E's format was adapted to meet the needs of all developmental/educational levels enrolled in the class. The lesson on the solar system was presented with confidence and enthusiasm. The teacher used hands-on demonstrations and visuals to explain concepts. Student-centered discussions were the preferred method employed by the teacher, and the

lesson began by asking students the question, *What is the solar system?*

The teachers interviewed reported that they used more technology in class, and had begun to do more journaling with their students as a result of participating in the project. Several teachers also described the special education strategies as being extremely helpful and useful. Interview and observation data also revealed that the participants attempted to integrate the new strategies, teaching practices, and content into their class lessons. Inquiry-based activities, collaborative group work, student-centered discussions, and hands-on labs were just a few of the common practices observed in classrooms throughout the years when teachers worked with students with diverse learning abilities.

The use of the 5E's method, the integration of technology, journaling, and the ways of including and addressing special needs in the classroom were by far the most talked about strategies and tools among all interviewees. It was also noted that students with cognitive challenges may benefit more from the use of concrete materials in learning as opposed to more of a content oriented instruction approach. The researchers assert that all students will demonstrate an affinity for science when an active teaching method is used as opposed to a passive one. This approach to teaching will have more of an impact with students who will be able to relate the teaching content with daily life experiences.

As a result of the professional development project, teachers incorporated the following instructional that helped them to meet the needs of diverse learners:

1. Established multiple learning centers within the classroom.
2. Integrating learning with student's prior knowledge
3. Provided a structured learning environment with consistent and lucid procedures.
4. Provided ongoing and frequent monitoring of individual student learning (formative assessment).
5. Implemented interactive computer programs and multimedia tools.
6. Used small-group and cooperative learning strategies.

Conclusion

The role of research in special education for students with diverse learning styles has been particularly significant. Providing appropriate special education and related services, i.e. aids and supports in the regular classroom to teachers is very important. School districts should provide support and high quality intensive professional development for all personnel who work with students with special needs in order to ensure that they have the necessary skills and knowledge that will enable them to meet the needs of the diverse learners. All students find science exciting and relevant when it is taught as an active rather that is a passive process. When students can relate what they are learning to their everyday lives, they feel a sense of ownership to the subject. As science teachers, it is important to consider and be aware of the needs of individual students. These diverse needs should be reflected in the curriculum. The science teacher of special needs learners must do much more that simply follow a fixed and prescribed curriculum, because the science teacher constantly has to adapt to the specific and unique special needs of the learner.

Recommendations

In order to have a solid curriculum for effective teaching and learning, the authors propose that all science teachers should incorporate the following in their approach to teaching:

1. Hands-on laboratory experiments
2. Cooperative learning activities such as Think, Pair, Share
3. Use of multimedia tools
4. Small group activities
5. Participant presentations
6. Demonstrations
7. Projects structured around a problem
8. Hands on learning activities using instructional materials.
9. One-minute reading comprehension

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Appendix A
5 E's Instructional Model

Engagement Phase:

The purpose of this phase is to develop an activity or activities that make a connection between prior knowledge and the new learning experience. This phase should include activities that:
• Captivates the student's interest (examples: scenario, problem, news articles, etc.
• Stimulates critical thinking.
• Connects prior knowledge with new concepts.
• Relates to real-world experiences.
Some examples of teaching strategies for the engagement phase include:
• Demonstrations
• Discussion of newspaper/magazine article
• Role playing

Exploration Phase:

The purpose of this phase is to provide students with hands-on minds-on experiences that enable them to identify, explore, or develop concepts, processes, and skills. During this phase students can investigate a problem, make observations, and organize collected data.
Some examples of teaching strategies for the exploration phase include:
• Laboratory experience
• Problem-solving activity
• Computer search
• Scenarios or role-play that encourage students (in small groups) to discuss a real-world problem, to purpose a hypothesis for solving the problem, and to justify (based on an investigation) the rational for their hypothesis.

Explanation:

This phase encourages students to interpret and statistically analyze data from their explorations, develop explanations, and refine or adjust previously formed concepts. During this phase the teacher can introduce new vocabulary and define and clarify new concepts, skills and processes.
Some examples of teaching strategies for the explanation phase include:
• Constructing/interpreting graphs
• Graphic organizers
• Guided reading activity
• Mini-lecture
• Guided discussion
• Computer assisted instruction
• Video

Elaboration:

The purpose of this phase is to extend student learning and to challenge students to understand and construct new knowledge. During this phase students can apply new concepts, processes, and skills.
Some examples of teaching strategies for the elaboration phase include:
• Teacher-directed student discussion
• Laboratory experience
• Problem-solving activity
• Research project – Communicate orally or in writing
• Production of a product or model

Adapted from 5 'E Instructional Model
http://www.miamisci.org/ph/lpintro5e.html

Appendix B

Survey: Teaching Science to Students with Special Needs in Inclusive Settings			
Please respond to the following questions or statements. Circle the answer where applicable.			
		Yes	No
1	Were you initially trained as a teacher?		
2	In which specialty area were you trained as a teacher? _____		
3	How many years have you taught as a teacher? _____		
4	Have special/inclusive students been identified in your class (es)?		
5	If you taught included students, have you ever read their IEP's?		
6	If you were not initially trained as a special education teacher, what was your area of training? _____		
7	Which content area do you currently teach?		

	_____		
8	If you have taught included students, did you get the human support you needed?		
9	Did a delegate represent you during the development of the IEP's or during the placement process?		
10	If you teach included students, should they be in your regular classes?		
11	If you teach included students, what do you need as support in order to do a better job of teaching? Human Resources Other Resources _____ _____ _____ _____ _____ _____		
12	Does it appear that you have more than your share of included students?		
13	How many years have you taught included students? _____		
14	Do you spend more time on issues to accommodate included students?		
15	Do you think you have lowered the intensity of your class (es)?		
16	Have you had any staff development, relative to included students?		
17	Would you like to have more information regarding included students?		

~~WHEN IN ROME …~~
~~: INFLUENCES ON SPECIAL EDUCATION STUDENT-TEACHERS' TEACHING~~

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~~*University of Hawaii*~~

~~*Student-teaching is the foundational professional experience for most special education teachers. We investigated the influences on preservice teachers' decision-making during their student-teaching through a two-part study. In the first phase, six undergraduate student-teachers at a large Midwestern university participated in focus group. Participants indicated that they made instructional decisions in five main areas (i.e., planning, teaching style, teaching methods, behavior management, and handling of a difficult moment) that were primarily influenced by their cooperating-teacher, previous*~~