Exceptional Children

Vol. 68, No. 4, pp. 423-435.
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Including Students With Disabilities Into the General Education Science Classroom

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ABSTRACT: *This article describes a school-based project designed to close the gap between research and practice by having project staff and teachers work together in the design and implementation of a science project designed to include junior high school students with severe emotional disturbances or learning disabilities into the general education science classroom. The outcomes of the project indicated there were no behavioral difficulties in the form of discipline referrals reported for the students with disabilities during the science class. Academic performance was measured by a districtwide science test and final grade.*

Public Law 94–142, *The Education of All Handicapped Children's Act*, brought a dramatic change to the education of students with disabilities (SWDs). One feature of this legislation was the Least Restrictive Environment (LRE) mandate, which required that *students with disabilities* be educated, to the maximum extent possible, along with the general student population. Public Law 105–17, commonly known as the *Individuals with Disabilities Education Act (IDEA)Amendments of 1997*, fully supported the least restrictive mandate and stipulated further that SWDs have access to and make progress in the general education (GE) curriculum. This paper reports a school-based project that demonstrates that students with serious emotional disturbances (EDs) or learning disabilities (LDs) satisfied the intent of the amendments in that the students and their teachers clearly had access to and made progress in the GE science curriculum.

This article does not report an experimental study. Rather, it reports on a project designed and conducted by project staff and classroom teachers, and it demonstrates two important factors. First, it demonstrates that teachers and project staff can work together to design and implement program modifications and evaluations of those modifications. This cooperative effort addressed the concerns of Fuchs and Fuchs (1998) that the gap between research and practice is indisputable and troubling as practitioners do not use the knowledge produced by educational research. A possible reason for this is that the researchers are not listening to the teachers or they are conducting research that is not among the priorities of the teachers. This project demonstrates that it is possible to narrow the longstanding gap between research and the schools (e.g., Abbott, Walton, Tapia, & Greenwood, 1999; Chandler, 1981). The project addressed an additional concern, *implementation* (Allinder, 1996; Gresham, MacMillan, Beebe-Frankenberger, & Bocian, 2000), where the combinations of outcomes and classroom observations indicate that the teachers did implement a program based on their training as a team and that the students actively participated (Piccillo, 1994).

Second, it demonstrates that teachers of different disciplines can work together to enhance student performance, provided the training is of a sufficient magnitude to develop proficiencies and opportunities to "bond" together to implement the framework of the training program.

One concern when attempting to include SWDs into the GE classroom is the receptiveness of the GE teacher. A major obstacle can be the teacher's perception of how that student will behave. In the past teachers have reported that the students will have a negative effect on the teachers' programs and the GE students and that the teachers would be unable to provide for them in the GE classroom (Vacc & Kirst, 1977). This fear is understandable if the GE teachers are given little or no support and the special education (SE) teachers are unable to contribute effectively to the content classroom. To illustrate, a survey of science teachers and university science educators (Norman, Casseau, & Stefanich, 1998) showed that teacher education programs for science educators reflect little concern for preparing science teachers to work with SWDs. The science teachers had minimal training and experience with SWDs, and their courses failed to include research relative to best practices. This was not the case in the present project as the purpose of the training was to assist science teachers to better meet the needs of SWDs and to provide SE teachers with a degree of science knowledge that would enable them to provide consultation and also participate in the science classroom. In effect, the science teacher learned about SWDs, and the SE teachers learned science.

The inclusion of students with serious EDs or LDs must consider social adjustment, behavioral functioning, and academic success. With regard to social adjustment, Hoyle and Serafica (1988) found lower peer status of students with LDs on peer nominations. A subsequent study (Juvonen & Bear, 1992) showed that two-thirds of students with LDs studied had at least one reciprocal friend but were viewed by teachers as less socially and academically competent than the general education students. A later study of teacher attitudes toward included students (Cook, Tankersley, Cook, & Landrum, 2000) indicated that SWDs were less frequently represented in the category of teacher attachment and more frequently represented in the category of teacher rejection.

Students with LDs exhibit less task-oriented behavior and more nonconstructive off-task behavior (McKinney, McClure, & Feagans, 1982). One challenge for GE and SE teachers is to prevent students' behaviors from interfering with their academic success. In a later study (Carr & Punzo, 1993), the students were required to monitor their own work completion, thus putting the focus on academic performance rather than on behavior. It was found that the students' productivity and accuracy levels increased, and the management of behavior was addressed through internal rather than external controls.

Academic success is one type of evidence of success in assimilating students with serious EDs or LDs. Ruhl and Berlinghoff (1992) found only 15 empirical studies of academic success, all but two of which were either exclusively instructional or motivational. Janczak (1993) contrasted the performance of students with serious EDs enrolled in private residential schools with students not having a disability on the New York Regents

Competency Test in Science. Ninety-four percent of students with serious EDs passed the test in contrast to 85% of students who did not have a disability.

A relevant study by Sharpe, York, and Knight (1994) examined the academic performance of GE students enrolled in classes with SWDs and in classes without SWDs. There were no significant differences in the reading, language arts, or mathematics performance of the SWDs in either condition. This is an important finding because one of the arguments against having SWDs in the GE classroom is that such placements will have a negative effect on other students. The present article expands upon the Sharpe, et al. article by examining both the academic and behavioral performance of students with and without disabilities in the context of a GE science classroom. Schicke (1995) studied the differences between SE and GE classroom placements for SWDs and behavior disorders on samples of 824 GE classrooms and 536 SE classrooms. Although there were many similarities (e.g., levels of noise), there were distinct differences. The GE science classroom focused more on lectures and students displayed more task management and competing behaviors. Students in SE classrooms showed more academic responses and received much more approval from the teachers.

In the main, neither SE nor science education has developed and validated comprehensive programs of science education to meet the needs of students with severe EDs or LDs in the GE classroom. There have been a number of efforts conducted by individual researchers and two comprehensive efforts conducted by Mastropieri and Scruggs and their colleagues (e.g., Scruggs, Mastropieri, Bakken, & Brigham, 1993) and by Lovitt and his colleagues (Lovitt & Horton, 1994).

For example, Holahan and DeLuca (1993) conducted a 10-week *theme-based* intervention with three classes of SWDs. The intervention focused on two themes, *structure* and *change*, which were presented in a "hands-on" manner to the students 4 days per week. Posttest scores on four measures were near double or double the pretest scores, and these scores were maintained on a 13-week followup. DeLuca (1997) followed up on the theme-based approach and compared the performance of two self-contained classrooms for students with serious EDs. One class utilized a textbook approach and the other a "hands-on" approach. Students in the "hands-on" classroom performed higher than those in the textbook classroom.

In the main, neither special education nor science education has developed and validated comprehensive programs of science education to meet the needs of students with severe EDs or LDs in the GE classroom.

Scruggs et al. (1993) had students with LDs from four classrooms study two science units using either an activity-based or a textbook approach. Students in the activity-based program performed significantly higher on immediate and delayed unit tests than did the students using the reading approach. Students reported a preference for activity-based learning.

In another study, Scruggs and Mastropieri (1994) evaluated the construction of scientific knowledge by students with mild disabilities using the Full Option Science System (FOSS) Environmental Unit. The data consisted primarily of field notes and led the researchers to note that (a) positive outcomes are associated with implementation by teachers; (b) numerous adaptations made by teachers such as added activities/increased redundancy enhance performance; and (c) structured coaching by teachers is related to knowledge construction.

Lovitt and Horton (1994) conducted a number of projects designed to modify science textbooks so that science knowledge would be more accessible and more beneficial to SWDs. Lovitt's work is important as both the GE and the SE science classrooms are dominated by textbook-based instruction. There is sufficient information to question the appropriateness of using the textbook as SWDs seldom read well enough to use a text (Parmar, DeLuca, & Janczak, 1994) or in programs where the modifications in science recommended for use with SWDs are irrelevant (Parmar & Cawley, 1993).

The science class is potentially one of the more promising classes in which to provide an appropriate education in the LRE because it has the capability (a) to allow students to interact, share, and collaborate during their learning experiences; (b) for teachers and students to assist one another during instructional activities; and (c) to offer a variety of multimedia opportunities for learning and performance. This is especially important at the junior high school level as students are preparing for the academic demands of secondary school.

However, one study (Anderman, 1998) examined the achievement gap between 296 adolescents with disabilities and 1,608 adolescents without disabilities and found a significant gap in achievement between the groups at Grade 8. Anderman concluded that the programs of the typical middle school are incompatible with the educational needs of SWDs.

PURPOSE

The present project examined the science achievement and behavior of SWDs and students without disabilities in GE science classes that enrolled SWDs and science classes that did not enroll SWDs. The project also sought to demonstrate that university staff and teachers in the schools could work together to close the gap between research and practice.

METHOD

Teacher Participants and Program

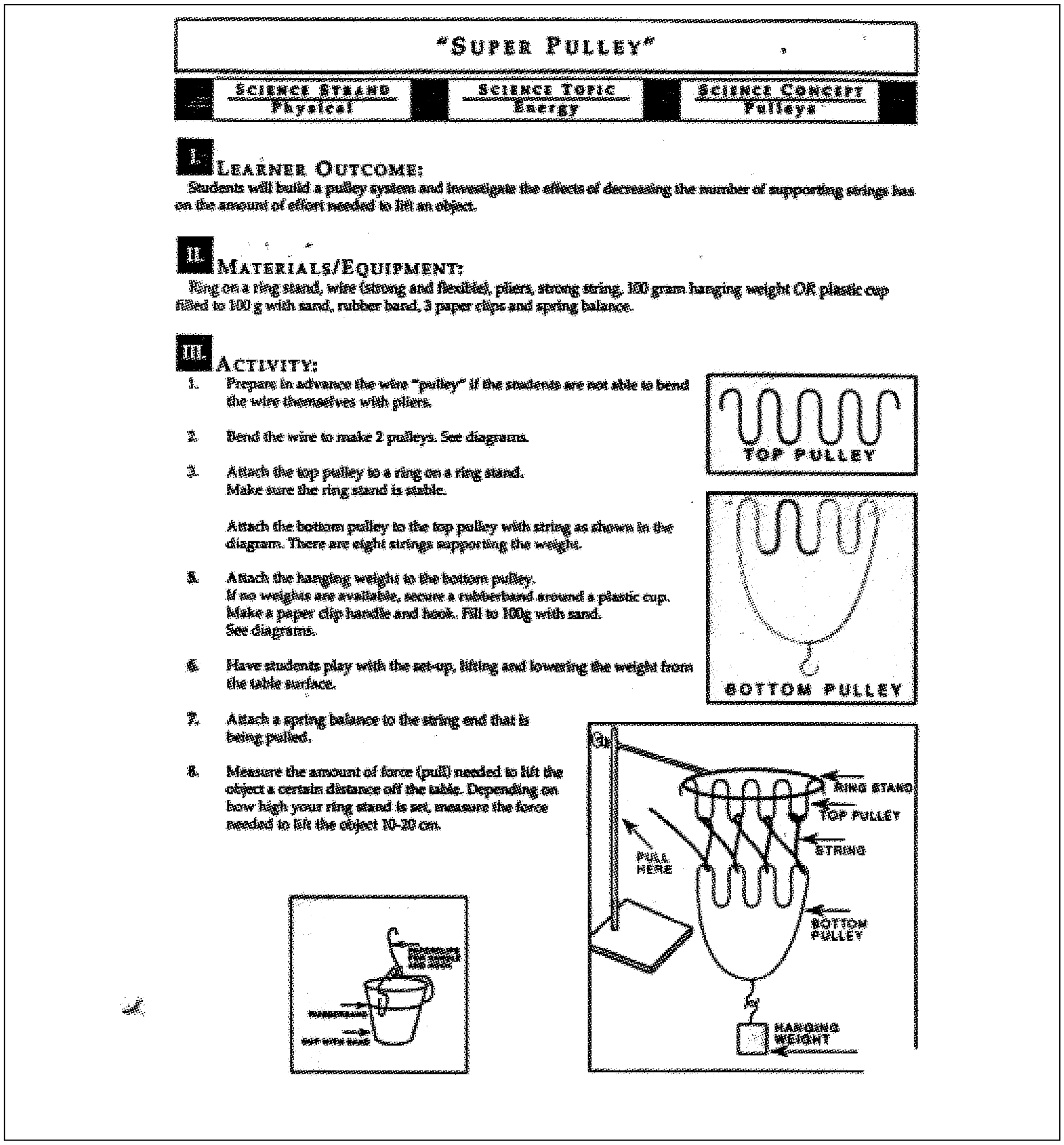
Fifteen three-person teams were provided with a training program of 100 hours. All teachers were certified in their respective areas, and all were actively teaching in the junior high school. During the initial 80-hour summer program, each team participated in two activities. First, each team conducted a long-term project (e.g., constructing acceleration ramps) to which it devoted 30 minutes each morning for 13 days. On the 14th day, each team presented its long-term project to the group. Second, each team completed four "hands-on" activities each day for 14 days (see Figure 1). These "hands-on" activities were designed to represent the curricula of the junior high and were presented in clusters lasting 2 to 4 days on a single topic (e.g., machines).

It was expected that the teams would return to their schools and present science from a "hands-on" perspective. The final evaluation of the project, which was based on classroom observations, interviews, and questionnaires with the teachers and students clearly indicated that the teachers did do this. Three anecdotal accounts support this. In one 1,100-pupil school, the teachers presented a workshop on the summer program. So impressed was the school principal that he relieved the science teacher of all extraneous duties (e.g., bus duty) and provided her with free time to work with other teachers. In a second school, the principal informed project staff that she was going to transfer the science teacher because of his inability to adapt to the needs of the students. She remarked that the summer program totally changed him and that upon returning to school he "buried" the textbooks in a closet. Third, one of the authors of this article (Elsa Cade) was nominated by the project for the Outstanding Science Teacher of the Year Award to be given by the National Science Teachers Association. She was a semifinalist for that award based on her work with SWDs.

The hands-on activities for the workshop were constructed and presented by junior high school science teachers who served as mentors during the summer workshop. The mentors served the project by guiding the conduct of the activities for the initial 2 days of the program and by then serving as consultants as the teams of teachers conducted the activities independently. This added credibility to the program as the mentors were able to describe how the activities augmented or supplemented the GE curriculum, and the teachers viewed the mentors as "one of them."

Upon completion of the summer program, each team was requested to develop a plan that would enhance the science program of its school to the benefit of all students, especially SWDs. This reports on one of those plans. The team participating in the present project consisted of a science teacher with 10 years of experience, a Grade 8 SE teacher with 8 years of experience, and a Grade 7 SE teacher with 14 years of experience.

FIGURE 1
Inservice Training Activity



"SUPER PULLEY"

SCIENCE STRAND	SCIENCE TOPIC	SCIENCE CONCEPT
Physical	Energy	Pulleys

I. LEARNER OUTCOME:
Students will build a pulley system and investigate the effects of decreasing the number of supporting strings has on the amount of effort needed to lift an object.

II. MATERIALS/EQUIPMENT:
Ring on a ring stand, wire (strong and flexible), pliers, strong string, 100 gram hanging weight OR plastic cup filled to 100 g with sand, rubber band, 3 paper clips and spring balance.

III. ACTIVITY:

1. Prepare in advance the wire "pulley" if the students are not able to bend the wire themselves with pliers.
2. Bend the wire to make 2 pulleys. See diagrams.
3. Attach the top pulley to a ring on a ring stand. Make sure the ring stand is stable.

   Attach the bottom pulley to the top pulley with string as shown in the diagram. There are eight strings supporting the weight.

5. Attach the hanging weight to the bottom pulley. If no weights are available, secure a rubberband around a plastic cup. Make a paper clip handle and hook. Fill to 100g with sand. See diagrams.
6. Have students play with the set-up, lifting and lowering the weight from the table surface.
7. Attach a spring balance to the string end that is being pulled.
8. Measure the amount of force (pull) needed to lift the object a certain distance off the table. Depending on how high your ring stand is set, measure the force needed to lift the object 10-20 cm.

STUDENT PARTICIPANTS

The participants included 114 junior high students from an inner-city neighborhood school (see Table 1). The poverty rate for the entire school (as measured by the number receiving free lunches) was 97%. Seventy-two percent of the students were minorities. The junior high school consisted of six homerooms: 2 Grade 8 classes, 2 Grade 7 classes, and 2 SE classes. The SE homerooms were comprised of students with serious EDs or LDs, of whom 51.8% were male and 48.2% were female. One GE science classroom at each grade level was chosen for inclusion and the other was used as a comparison group.

The population consisted of two GE Grade 7 classes, two GE Grade 8 classes, and two SE classes with Grade 7 and 8 students. One SE class had a 15:1 student–teacher ratio with an academic focus. The other SE class had a 12:1:1 student–teacher–teacher aide ratio with a combined academic/behavioral focus. The GE science set-

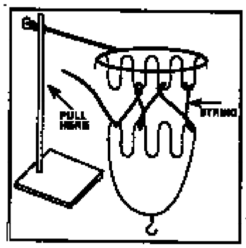
FIGURE 1 *(Continued)*
Inservice Training Activity

9. Change the number of strings supporting the object. See diagram.

   Six strings now support the weight.

10. Record the force necessary to pull the object.

11. Repeat step 8, 9, and 10; but change the number of supporting strings to 2 and 4.



IV. SCIENCE EXPLANATION:

With decreasing number of strings supporting the weight, the amount of force needed to lift the mass will increase. The weight of the object is divided amongst the supporting strings. If two strings support the weight, then each string is supporting half of the weight, and the amount of the force needed to lift the object will be half of its weight. If eight strings support its weight, then each string is supporting one eighth of the weight, and the amount of force needed to lift the object will be 1/8 of its weight.

Have the students generalize the observed trend in one statement: The more strings supporting the weight, the less the force needed to lift the weight. Student observations will be placed in the data table below.

DATA TABLE:

NUMBER OF STRINGS SUPPORTING THE WEIGHT	AMOUNT OF FORCE NEEDED TO LIFT OBJECT
8	
6	
4	
2	

V. EXPECTED RESULTS:

The student data will resemble the following: 8 strings = 12 grams
6 strings = 18 grams
4 strings = 25 grams
2 strings = 50 grams

Systems: The pulleys working together can get the job done.

Relationship: Students will recognize that a decrease in the number of supporting strings increases the effort of force needed.

ting consisted of one teacher who taught two sections of life science to Grade 7 students and two sections of physical science to students in Grade 8. At each grade level, one SE teacher and the SE students at that level were included in the science class. Consequently, the SWDs were combined by grade level rather than by disability. When one sample was in science, the other SE teacher taught English to the students from both options at the appropriate grade content level.

The SE teacher spent the entire science period each day in the science classroom with the science teacher and the GE students. The SE students were assigned the same work as the GE students (see Table 2. The SE teacher graded the Grade 8 SE students, and the Grade 7 SE students were graded by the science teacher. All students were required to maintain a portfolio in the form of a notebook with a table of contents and to keep track of their own work. All three teachers periodically checked notebooks. Tests were taken from the end of each unit of the textbook. There was also a project and a solid waste portfolio that counted toward the final exam grade. The final exam was the district science test. For this project, the academic attainment of the students was determined by their performance on the citywide final exam and their final average for the class. The special considerations extended to the SWD were the use of teacher-made study guides and

Table 1

FIGURE 2

Course Content for Grades 7 and 8

Grade 7	Grade 8
Matter and life	Motion
Life processes of cells	Energy
Simple living things	Waves
Protists and fungi	Light
Classifying plants	Electric charge
Plant life processes	Magnetism
Simple invertebrates	Heat
Circulation	Matter
Respiration and excretion	Atoms
Control systems	Kinds of atoms
Development and heredity	Atomic bonds
The ecosystems	Acids, bases, and salts

extra study sessions during study hall. Test modifications were limited to the use of alternate test sites, extended time, and the reading of the test to the student as stated in the individualized education program (IEP). No changes were made in the test or the scoring.

The social adjustment of the students was evaluated by anecdotal records written by the teachers. The discipline of the students was monitored through discipline referrals. School policy is that any student who is sent to the office must be accompanied by a written referral. These referrals were counted and compared.

Attendance records of each class were recorded based on the number of possible days of attendance. Although the school year consisted of 180 days, not all students were registered for that amount of time. Students who may have attended school but were not present at exam time were not included in the study.

> *According to teacher observations, the special education students enjoyed a much higher level of social acceptance than when they remained in a self-contained class all day.*

RESULTS

Academic

The total group of 114 students scored a mean of 69.24 (*SD* of 15.14) on the final exam and a mean of 71.52 (*SD* of 11.58) on the final grade (see Table 2).

Social

The teachers reported that the SE students were fairly well accepted by the GE students. Within the science class the students were allowed to sit where they wanted. Most of the SE students preferred to sit with each other with some outstanding exceptions. There were two boys who daily sat with a group of GE girls and were dating GE students. There were a number of GE students who consistently chose to sit with the SE students. There were several instances of the GE students inviting the newer SE students to sit with them. Aside from a few isolated incidences of name-calling, the teachers did not feel that the SE students were being treated poorly or differently because of their disabilities.

Table2

The teachers reported that they saw differences in the way the SE and GE students treated each other outside the science classroom. The school had an evening dance and a large number of SE students attended and participated in the festivities. Teachers reported that on a daily basis SE students and GE students could be seen exchanging social amenities with each other verbally, physically, and through written notes. Conversations were what one might expect of any adolescent. According to teacher observations, the SE students enjoyed a much higher level of social acceptance than when they remained in a self-contained class all day.

Another result reported by the teachers was the change in their own status in relation to the GE students. Rather than being separated and viewed solely as SE teachers, the SE teachers had become an integral part of the day of the GE students. The GE students viewed the SE teacher as one of their science teachers. On several occasions, the GE student introduced the SE teacher to his parent this way. The SE teachers were able to have input into the progress reports and parent conferences for the GE students.

Behavior and Attendance

There was a total of 182 discipline referrals for the entire sample. These are presented in Table 3. The Grade 8 sample of SE students had a total of 30 referrals outside science class at a rate of 5 per class and 0 referrals during science. The GE Grade 8 inclusion class had a total of 52 referrals outside science at a rate of 8.7 per class and 4 referrals during science. The GE Grade 8 noninclusion class had a total of 26 referrals outside science at a rate of 4.3 per class and 3 during science. The SE Grade 7 class had a total of 8 referrals outside science at a rate of 1.3 per class and 1.3 during science. The SE Grade 7 inclusion class had a total of 30 referrals outside science at a rate of 5 per class and 3 during science. The SE Grade 7 noninclusion class had a total of 36 referrals outside science at a rate of 6 per class and 0 during science class.

Conclusions

The academic success of the 16 SE students was comparable to the passing rate of the GE students. That is, 11 of the 16 SE students, or 69%, passed the district exam. This is equal to the rate at which the GE students passed the exam. The final grade of the GE students was the same, while the passing rate for the SE students was higher. This result can be attributed to averaging quarterly grades. The GE students who failed were consistently doing poorly all year. Some GE students were able to pass on their average even though they did not pass their exam. The behavior of the SE students posed no problem in the science class, and the behavior of the GE students was not affected in a negative way by the presence of the SE students. The behavior of the GE students was better during science, and in one case, a class had 50% fewer discipline referrals than a class not having SE students as members.

The inclusion of activities that supported or augmented specific elements of the program made them readily acceptable to the teachers for classroom use.

The science class is characterized by extensive interpersonal contact between and among students and teacher(s). This is consistent with our earlier statement relative to the potential of the science class as a basis for addressing an appropriate education within the LRE. Claims about SWDs adversely affecting the GE students and not making academic progress on their own are not supported by this project. To the contrary, many of the claims about the behavior and academic performance of SWDs in GE classrooms are challenged. Our general indicators, although somewhat informal, show a trend toward inclusion of SWDs in the GE science classroom.

Practical Implications

Our initial thoughts relative to practical implications focus on the design of the inservice training program. The program involved teams of teachers representing the fields of science and SE. The

Table 3

content of the training adhered to the principles of meaningful science and it presented the science in the "hands-on" manner, which the teachers were expected to use in the classroom. The inservice training included an 80-hour summer program and a 20-hour academic year followup. This provided the teachers with an opportunity to learn from one another and to engage one another in the process of collaboration. One important feature was the inclusion of mentors to design the training activities and to present them. The inclusion of activities that supported or augmented specific elements of the program the teachers are working with made them readily acceptable to the teachers for classroom use. The aforementioned are meaningful implications for those who design, conduct, and fund inservice training.

Finally, it appears that teachers and researchers can work together. The "hands-on" approach to science for SWDs has been extensively researched and validated (e.g., Bay, Staver, Bryan, & Hale, 1992; Dalton, Morocco, Tivnan, Mead, & Rawson, 1997). A training program based on the research, when accompanied by easily utilized classroom materials and practices, serves to translate research to practice.

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Preparation of this article was aided by a grant, Science for the Handicapped, from the Teacher Enhancement Program, National Science Foundation (TEP9055527). The views are those of the authors and do not necessarily represent the views of the National Science Foundation.

Manuscript received March 2001; accepted Novemer 2001.

WE ARE PLEASED TO ANNOUNCE OUR NEW PH.D. PROGRAM IN SPECIAL EDUCATION AT UNC CHARLOTTE. The UNC Charlotte Special Education Ph.D. Program provides training to be innovators, teachers, leaders, and researchers. We anticipate that our graduates will be special education administrators, teacher educators, and researchers who have skills in all of these areas. The coursework is designed for either fulltime or intensive part-time (two courses per semester) study. Students prepare a portfolio of their work while in the doctoral program including manuscripts submitted for publications, evidence of effective college teaching, consultation to schools, and participation in professional organizations. Funds are available for both full ($19,000 per year) and part-time students through a "Preparation of Leadership Personnel" grant from the U.S. Department of Education, Office of Special Education Programs. We admit students one time each year and our ongoing application deadline is December 1st. For more information, check out our Web site at http://www.uncc.edu/spedphd or contact Dr. Diane Browder, Doctoral Coordinator at dbrowder@email.uncc.edu; Phone: 704/687-4012.

Gwinnett County Public Schools

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